UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

September 1, 2005

Mr. David E. Strainge
AFBCA/DA Loring, Pease, & O'Hare
154 Development Drive, Suite G
Limestone, ME 04750-9743

Re: Five-Year Review Report (2000 to 2005), Loring Air Force Base NPL Site

Dear Mr. Strainge:

This office is in receipt of the Air Force's *Five-Year Review Report (2000 to 2005), Loring Air Force Base* dated August 2005. Upon review of this report, EPA concurs with the findings that all remedies which have been implemented are currently protective of human health and the environment.

This second five-year review was triggered by the first remedial action which was documented by EPA to be September 30, 1995. Consistent with Section 121(c) of CERCLA and EPA's *Comprehensive Five-Year Review Guidance* (OSWER *Directive 9355.7-03B-P)*, the next statutorily required five-year review must be finalized by September 30, 2010.

Sincerely,

Susan Studlien

Susan Studlien, Director
Office of Site Remediation and Restoration

cc: Bryan Olson, EPA-New England
Mary Sanderson, EPA-New England
Mike Daly, EPA-New England
Katherine Garufi, EPA HQ
Naji Akladiss, MEDEP

U.S. AIR FORCE

Former Loring Air Force Base
Limestone, Maine

5 Year Review Report (2000 to 2005)

August 2005
Contract No. F41624-03-D-8608
Task Order No. 0058

U.S. AIR FORCE

Former Loring Air Force Base, Limestone, Maine

5 Year Review Report (2000 to 2005)

August 2005

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN)**:** Loring Air Force Base		
EPA ID (from WasteLAN) **:** ME9570024522		
Region: 1	**State:** ME	**City/County:** Limestone/Aroostook

SITE STATUS	
NPL Status: **X** Final Deleted Other (specify)	
Remediation Status (choose all that apply)**:** Under Construction **X** Operating **X** Complete	
Multiple OUs? **X** Yes No	**Construction completion date:** 10/31/2000
Has Site been put into reuse? **X** Yes No	

REVIEW STATUS	
Lead Agency: EPA State Tribe **X** Other Federal Agency United States Air Force	
Author name: Brett M. Lester	
Author title: Project Hydrogeologist	**Author affiliation:** MWH Americas, Inc.
Review Period: September 30, 2000 to September 30, 2005	
Date(s) of inspection: N/A (see report)	
Type of Review: **X** Post-SARA Pre-SARA NPL-Removal Only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion	
Review number: 1 (first) **X** 2 (second) 3 (third) Other (specify) _____	
Triggering Action: **Previous Five-Year Review Report** 1st 5-yr review: Actual RA On-Site Construction at OU 6 2nd 5-yr review: Previous Five-Year Review Report	
Triggering action date (from WasteLAN): 9/30/2000	
Due date (five years after triggering action date): 9/30/2005	

Five-Year Review Summary Form, cont'd.

Issues:

- Several changes to ARARs have occurred which have not affected remedy protectiveness
- Cadmium, lead and zinc not detected above MCL or Action Levels at Landfills 2 and 3 since 1997
- Additional contamination was encountered at the Base Laundry (OU 11) during remedial action optimization evaluation

Recommendations and Follow-up Actions:

- New ARARs will be identified in future long term monitoring reports
- Appropriateness of continued monitoring of cadmium, lead and zinc at Landfills 2 and 3 will be evaluated during long-term monitoring
- Implementation of the selected remedial optimization at the Base Laundry will be completed during the 2005 construction season
- ES/JEBS, GMZ-1 and GMZ-3 will be reviewed and vapor intrusion will be further evaluated

Protectiveness Statement:

The remedies for all sites are protective of human health and the environment now or are expected to be protective of human health and the environment upon completion, and all immediate threats to human health and the environment have been addressed.

FORMER LORING AIR FORCE BASE
FIVE-YEAR REVIEW REPORT (2000-2005)

Prepared for:

Air Force Real Property Agency (AFRPA)
154 Development Drive, Suite G
Limestone, Maine 04750

Air Force Center for Environmental Excellence (AFCEE)
Base Conversion Directorate - East (AFCEE/BCE)
Brooks City-Base, TX 78235-5328

Prepared by:

MWH Americas, Inc.
335 Phoenixville Pike
Malvern, PA 19355

August 2005

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ACRONYMS AND ABBRIVIATIONS

µg/L	Micrograms per liter
1,2,4-TMB	1,2,4-trimethylbenzene
ABB-ES	ABB Environmental Services, Inc.
AEWs	air extraction wells
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AFRPA	Air Force Real Property Agency
AHS	Auto Hobby Shop
ARAR	Applicable or Relevant and Appropriate Requirements
AST	aboveground storage tank
BB/LS	Butterfield Brook/Limestone Stream
BCT	BRAC Cleanup Team
BEHP	bis(2-ethylhexyl)phthalate
bgs	feet below ground surface
BIA	Bureau of Indian Affairs
BL	Base Laundry
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
BXSS	Base Exchange Service Station
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CG	Cleanup Goals
cis-1,2-DCE	cis-1,2-dichloroethene
CNDA	Central Nose Dock Area
COC	Contaminants of Concern
COPC	contaminants of potential concern
CSS	Contractor's Storage Shed
CSSA	Contractor's Storage Shed Area
CVOC	Chlorinated Volatile Organic Compound
cy	cubic yards
DC	Double Cantilever
DCA	identified 1,1-dichloroethane
DCE	1,1-dichloroethene
DHS	Department of Human Services
DRMO	Defense Reutilization and Marketing Office
EBGB	East Branch Greenlawn Brook
EE/CA	Engineering Evaluation/Cost Analysis
ELCR	excess lifetime cancer risk

ACRONYMS AND ABBRIVIATIONS

EOD	Explosive Ordnance Disposal
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ES	Entomology Shop
Fe^0	zero-valent iron
FFA	Federal Facilities Agreement
FJETC	Former Jet Engine Test Cell
FLA	Flightline Area
FLDD	Flightline Drainage Ditch
FS	Feasibility Study
FSF	Flightline Structural Feature
FSSB	Former Solvent Storage Building
ft	Feet
ft./sec.	feet per second
ft/day	feet per day
ft/ft	feet per foot
FS	Feasibility Study
FTA	Fire Training Area
FTF	Fuels Tank Farm
gal	Gallon
GB	Greenlawn Brook
GMZ	Groundwater Monitoring Zone
gpm	Gallons per minute
IC	Institutional Controls
IR	Intrinsic Remediation
IRP	Installation Restoration Program
IWQPP	Installation-Wide Quality Program Plan
JEBS	Jet Engine Buildup Shop
JETC	Jet Engine Test Cell
JP-4	jet fuel
LA	Limited Action
LDA	Loring Development Authority
LF2	Landfill 2
LF3	Landfill 3
LMR	Little Madawaska River
LNAPL	Light Non-Aqueous Phase Liquid
Loring AFB	Loring Air Force Base
LTM	Long-Term Monitoring
LTMP	Long Term Monitoring Plan
LUC	Land Use Control
LUC/IC	Land Use Controls/Institutional Controls
MCL	maximum contaminant level
MEDEP	Maine Department of Environmental Protection
MEG	Maximum Exposure Guidelines

ACRONYMS AND ABBRIVIATIONS

MSL	mean sea level
MWH	MWH Americas, Inc.
NCP	National Contingency Plan
NPL	National Priority List
O&M	Operations and Maintenance
OFR	Outdoor Firing Range
OPS	Operating Properly and Successfully
OU	Operable Units
OWS	oil water separator
PA/SI	Preliminary Assessment/Site Investigation
PAH	Polynuclear Aromatic Hydrocarbons
PCB	410/polychlorinated biphenyls
PCE	tetrachloroethene
PQL	practical quantitation limit
PVC	Poly-Vinyl Chloride
RA	risk assessment
RAO	Remedial Action Objectives
RG	Restoration Goals
RI	Remedial Investigation
RI/ASI	Remedial Investigation/Additional Site Assessment
RI/FS	remedial investigation and feasibility study
ROD	Record of Decision
SI	site inspection
SVE	soil vapor extraction
SVOC	semi-volatile organic compounds
TCE	Trichloroethylene
TI	Technical Impracticability
TPHs	total petroleum hydrocarbons
USAF	U. S. Air Force
USFWS	U.S. Fish and Wildlife Service
UST	Underground Storage Tank
UTS	Underground Transformer Site
VMB	Vehicle Maintenance Building
VOC	Volatile Organic Compounds
WB/BB	Wolverton Brook/Brandy Brook
WBGB	West Branch Greenlawn Brook
yd^3	Cubic yard

EXECUTIVE SUMMARY

The Air Force Real Property Agency (AFRPA) has initiated a Five-Year Review for the former Loring Air Force (Loring AFB) in Limestone, Maine. The review was conducted under the Air Force Center for Environmental Excellence (AFCEE) Contract No. F41624-03-D-8608, Task Order 58. The Air Force is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). A Five-Year Review is required for the former Loring AFB, because the implemented remedies have resulted in hazardous substances remaining onsite at concentrations that do not allow for unlimited use and unrestricted exposure and the remedial actions at some sites will require greater than five years to complete. This document represents the second Five-Year Review for the former Loring AFB, and encompasses the period 2000 through 2005.

The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this *Five-Year Review Report*, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

Each of the sites included in the Five-Year Review has a remedy in place. Therefore, technical assessments, as required under EPA guidance, were performed for each of the sites. These assessments consisted of answering the following questions:

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Sites included in the Five-Year Review were organized into two categories:

Statutory Review Sites

- Operable Unit 2 and Operable Unit 4 – Landfill 2 and Landfill 3
- Operable Unit 3 – Contractor's Storage Shed
- Operable Unit 3 – Explosive Ordnance Disposal Range and Outdoor Firing Range

Policy Review Sites

- Operable Unit 5 – Former Jet Engine Test Cell
- Operable Unit 8 – Fire Training Area
- Operable Unit 9 – Auto Hobby Shop
- Operable Unit 10 – Entomology Shop and Jet Engine Buildup Shop
- Operable Unit 11 – Base Laundry
- Operable Unit 12 – Basewide Groundwater
- Operable Unit 13 – Basewide Surface Water and Sediment

Based on the review, remedies at all sites were found to be functioning as intended by the decision documents. While the remedy at the Base Laundry (BL) is functioning as intended, optimization activities undertaken at the BL to achieve Remedial Action Objectives (RAOs) in a timely manner resulted in the determination that the areal extent of tetrachloroethylene (PCE) in soil is greater than that determined during the remedial investigation (RI). An alternative remedy consisting of partial demolition of the BL building and excavation and landfarming of soils containing PCE above the remediation goal (RG) has been agreed upon by the Air Force, the United States Environmental Protection Agency (EPA) and the Maine Department of Environmental Protection (MEDEP), and is scheduled to be completed in 2005. It is anticipated that at the completion of the remedy optimization the remedial action objectives (RAOs) for the BL will be achieved. A change in the ARAR for arsenic in groundwater was noted in the Sections 7.3 and 8.8 of this *Five-Year Review Report.* No additional information was

identified that would call into question the protectiveness of any of the individual remedies associated with the sites.

Several issues were identified during the Five-Year Review process. These issues are listed below, on a site-by-site basis. These issues will be addressed during routine site monitoring, data evaluation, and reporting activities, with the exception of the following:

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Actions: Affect Protectiveness (Y/N)	
				Current	Future
Revisions to the Landfills 2 and 3 Post Closure Maintenance and Monitoring Plan.	Air Force Real Property Agency (AFRPA)	EPA/ MEDEP	Summer 2005	N	N
Implement remedial alternative at Base Laundry site.	AFRPA	EPA/ MEDEP	Summer 2005	N	N
Consider ES/JEBS, GMZ-1 and GMZ-3 vapor intrusion concerns.	AFRPA	EPA/ MEDEP	Summer 2006	N	N

Category/Zone/Site	Identified Issue	Recommended Action(s)
Statutory Review Sites		
Operable Units 2 and 4: Landfills 2 and 3	Decrease in Federal MCL for arsenic from 50 µg/L to 10 µg/L.	Note change in regulatory standards in future long-term monitoring reports.
	Cadmium, lead and zinc not detected above MCL or Action Level since 1997.	Evaluate appropriateness of continued monitoring.
Operable Unit 3: Contractor's Storage Shed	None.	None.
Operable Unit 3: Explosive Ordnance Disposal Range, Outdoor Firing Range	None.	None.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Policy Review Sites		
Operable Unit 5: Former Jet Engine Test Cell	None.	None.
Operable Unit 8: Fire Training Area	None.	None.
Operable Unit 9: Auto Hobby Shop	None.	None.
Operable Unit 10: Entomology Shop and Jet Engine Buildup Shop	None.	None.
Operable Unit 11: Base Laundry	Additional contamination encountered during optimization evaluation.	Implement optimization alternative during 2005 construction season.
Operable Unit 12: Basewide Groundwater	None.	None.
Operable Unit 13: Basewide Surface Water and Sediment	None.	None.

1.0 STATEMENT OF AUTHORITY AND PURPOSE

The Air Force Real Property Agency (AFRPA) (formerly Air Force Base Conversion Agency [AFBCA]) has initiated a Five-Year Review for the former Loring Air Force (Loring AFB) in Limestone, ME. The review was conducted under the Air Force Center for Environmental Excellence (AFCEE) Contract No. F41624-03-D-8608, Task Order 58.

The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this *Five-Year Review Report*, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

The Air Force is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The United States Environmental Protection Agency (EPA) interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

A Five-Year Review is required for the former Loring AFB, because some of the implemented remedies have resulted in hazardous substances remaining onsite at concentrations that do not allow unlimited use and unrestricted exposure, and the remedial actions at additional sites will require greater than five years to complete. This document represents the second Five-Year Review for the former Loring AFB, and encompasses the period 2000 through 2005. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) trigger for the first Five-Year Review was the substantial beginning of remedial action for Operable Unit (OU) 6 (USEPA, 2000). The first review was submitted in September 2000 (AFBCA, 2000). This second Five-Year Review is required to be submitted to the EPA five years after the first (September 2005).

1.1 REFERENCES

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September.

EPA, 2001. *Comprehensive Five-Year Review Guidance,* EPA 540-R-01-007.

USEPA, 2000. *Letter of Concurrence on First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* Spetember.

2.0 REPORT ORGANIZATION

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) indicates that the Five-Year Review Report should generally contain the following information:

- An introduction to the review;
- A site chronology and presentation of general site background information;
- A discussion of remedial actions that have taken place at the site;
- Description of progress since the last Five-Year Review, if applicable;
- A discussion of the Five-Year Review process;
- Technical assessment for each site;
- Identification of any issues arising from the review process;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- Identification of the expected date of the next Five-Year Review.

This *Five-Year Review Report* generally follows the report template found in the 2001 EPA Guidance. However, because of the number of sites involved in the review, certain modifications were made to make the data more accessible to the reader. Certain general information was presented in introductory sections. Tables and Figures are included in separate sections at the end of the document. The contents of each section of the *Five-Year Review Report* is as follows:

Section	Contents
1	Introduction to the *Five-Year Review Report*, stating the authority for, and purpose of, the review
2	Report Organization – Describes the organization of the *Five-Year Review Report.*
3	Methodology – Describes the overall process followed for the Five-Year Review.
4	Community Involvement – Describes the process for public involvement in the Five-Year Review process.

Section	Contents
5	Site Location and Description – Provides general background information for the former Loring AFB.
6	Report Summary – Provides summary maps and a summary table to assist the reader in locating specific site information in the *Five-Year Review Report.*
7	Statutory Review Sites – Provides detailed background information on sites where remedial actions that have been performed allow for hazardous substances, pollutants or contaminants to remain onsite. The review includes descriptions of remedial actions, progress since the last five-year review, technical assessments for individual sites, recommendations, and protectiveness statements.
8	Policy Review Sites – Provides detailed information on sites where remedial actions have been implemented that will allow for unlimited use and unrestricted exposure, but require more than five years to complete. The review includes descriptions of remedial actions, progress since the last five-year review, technical assessments for individual sites, recommendations, and protectiveness statements.

2.1 REFERENCES

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

3.0 METHODOLOGY

3.1 APPLICABLE GUIDANCE

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) was the primary document used to prepare this second *Five-Year Review Report* for the former Loring AFB. This guidance provides an overview of the review process and describes roles and responsibilities, components of the Five-Year Review process, and procedures for assessing the protectiveness of remedies.

3.2 SITE CATEGORIZATION

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) identifies criteria for determining when remedial activities require a five-year review under CERCLA. The *Guidance* indicates that a five-year review is required by Statute for those sites where the following conditions are true:

- Upon completion of the remedial action, hazardous substances, pollutants, or contaminants will remain on site; and
- The ROD for the site was signed on or after October 17, 1986 (the effective date of Superfund Amendments and Reauthorization Act of 1986) and the remedial action was selected under CERCLA §121.

The *Guidance* also indicates that a five-year review is required by a matter of EPA Policy for those sites where the following conditions are true:

- A remedial action that, upon completion, will not leave hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure, but requires five years or more to complete;
- A remedial action performed prior to the October 17, 1986 Superfund Amendments and Reauthorization Act of 1986 that leaves hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure.

Individual sites at the former Loring Air Force Base fall into one of these categories (statutory review or policy review). During the first *Five-Year Review Report* (AFBCA,

2000), sites were categorized as either a Statutory Review site or a Policy Review site. For this second *Five-Year Review Report*, sites will be categorized as they were in the first *Report*, for purposes of consistency.

3.3 SITE DATA

Numerous documents were reviewed for each site during the process of the Five-Year Review. These documents are cited as references at the end of individual sections of the report. These documents are maintained in the official Information Repository for the former Loring AFB, located at the AFRPA Office at 154 Development Drive, Suite G, Limestone, Maine.

3.4 INTERVIEWS AND SITE INSPECTIONS

Specific site interviews and inspections were not performed for this *Five-Year Review Report*. All sites included in the Five-Year Review are routinely inspected, and subject to ongoing monitoring and maintenance. Inspection logs included in annual reports, contractor and AFRPA personnel responsible for individual sites, and the onsite Operations and Maintenance (O&M) manager were consulted for specific information relative to the performance of individual remedies during preparation of this *Five-Year Review Report*.

3.5 TECHNICAL ASSESSMENTS

Each of the sites included in the Five-Year Review has a remedy in place. Therefore, technical assessments, as required under EPA guidance, were made for each of the sites in the three categories. These assessments consisted of answering the following questions:

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Section 4 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001) was used to develop appropriate responses to these questions. In general, the response to Question A was developed based on review of the Remedial Action Objectives (RAOs) set forth in the applicable Records of Decision (RODs), followed by assessment of current remedy performance data and progress toward cleanup goals. Question B was answered through an assessment of significant changes in standards and assumptions that were used at the time of remedy selection. Cleanup goals established based on promulgated standards were assessed for changes in those promulgated standards that have occurred since the last *Five-Year Review Report* (AFBCA, 2000) that would have an impact on remedy management. Where risk-based values were established as cleanup goals, the underlying toxicity data were also reviewed. Other information, such as potential changes in land use that could affect the protectiveness of the remedy was considered in responding to Question C.

3.6 REFERENCES

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September.

EPA, 2001. *Comprehensive Five-Year Review Guidance,* EPA 540-R-01-007.

4.0 COMMUNITY INVOLVEMENT

The Information Repository for the former Loring AFB IRP is maintained at the AFRPA Office at 154 Development Drive, Suite G, Limestone, Maine. Periodic Restoration Advisory Board (RAB) meetings are held to notify the public of significant milestones in the environmental cleanup program at the former Loring AFB, as required under the FFA. No specific requirement is included for public involvement in the Five-Year Review process; however, the public will be notified on the current progress of cleanup efforts and the Five-Year Review during the next RAB meeting.

5.0 SITE LOCATION AND DESCRIPTION

The former Loring AFB is located in Aroostook County in northern Maine, approximately 3 miles west of the Canadian (New Brunswick) border. As shown in Figure 5-1, the former AFB occupies approximately 9,000 acres and is bordered on the south and east by the Town of Limestone, on the north by the towns of Caswell and Connor, and on the west by the City of Caribou.

The Loring AFB was constructed in the late 1940s to support long-range bomber aircraft for the Strategic Air Command. Principal base operations included aircraft maintenance, refueling, munitions storage and maintenance, and flightline operations. Many of these activities required the handling, storage, or disposal of hazardous substances and petroleum products. As a result of these activities, hazardous substances and petroleum products have entered the environment through accidental spills, leaks in supply piping, landfilling operations, burning of liquid wastes during firefighter training exercises, and the cumulative effects of operations conducted at the base's flightline and industrial areas. As part of the Department of Defense's Installation Restoration Program (IRP), the Air Force initiated activities to identify, evaluate, and remediate former disposal or spill sites containing hazardous substances and petroleum products.

The Loring AFB was placed on the EPA's National Priority List (NPL) of sites in 1990. Under Section 120 of CERCLA, a Federal Facilities Agreement (FFA) between the EPA Region I, the Maine Department of Environmental Protection (MEDEP), and the Air Force was signed in January 1991, and amended in 1995. The FFA governs the environmental activities being conducted at Loring AFB. Following the signing of the FFA, LAFB was placed on the United States Congress Base Closure List (1991) and was closed in September 1994.

Pursuant to Section 120 of CERCLA and the FFA, the Air Force is responsible for addressing the hazardous substances at LAFB. In 1994, a Bottom Up Program review was conducted as part of the President's five-point fast-track cleanup initiative for closing military bases. Recommendations included performing early actions at sites where risks were well-defined. In accordance with CERCLA, Engineering Evaluation/Cost Analysis (EE/CA)

reports were developed for source control removal actions. The purpose of the source control removal actions was to address soil contamination identified at areas within the OUs during Remedial Investigation (RI) activities.

The FFA established fifteen OUs for Loring AFB according to geographic location, disposal type (e.g., landfill), or affected media, for which separate remedial investigation and feasibility study (RI/FS) reports were prepared. The OUs and the sites included in this *Five-Year Review Report* are:

- Operable Unit 2 (OU 2) includes the surface soils and solid waste contained in Landfills 2 and 3.
- Operable Unit 4 (OU 4) includes the groundwater associated with Landfills 2 and 3. Landfills 2 and 3 are located in the southwest portion of the former Loring AFB.
- Operable Unit 3 (OU 3) includes the soil and source control for several debris disposal areas including the Contractors Storage Shed Area, the Explosive Ordnance Disposal Range and the Outdoor Firing Range.
- Operable Unit 5 (OU 5) includes source control and removal of contamination in soils associated with the Former Jet Engine Test Cell.
- Operable Unit 8 (OU 8) includes recovery of light-non-aqueous phase liquid (LNAPL) from the shallow bedrock to remove a continual source of groundwater contamination.
- Operable Unit 9 (OU 9) includes source control and removal of contamination in soils associated with the Auto Hobby Shop.
- Operable Unit 10 (OU 10) includes source control and removal of contamination in soils associated with the Entomology Shop and Jet Engine Buildup Shop.
- Operable Unit 11 (OU 11) includes source control and removal of contamination in soils associated with the Base Laundry.
- Operable Unit 12 (OU 12) includes the affected groundwater media for the entire base excluding the area of the landfills included in OU 4.
- Operable Unit 13 (OU 13) includes the affected surface water and sediments media for various areas located throughout the base.

The locations of the Operable Units discussed in this Report are shown in Figure 5-2.

The Operable Units and the sites not included in this *Five-Year Review Report* are:

- Operable Unit 1 (OU 1) includes the source of contamination and impacts on media for radioactive waste areas located in the northeast section of the base. Restoration activities at OU 1 have made the site available for unlimited use and unrestricted exposure. Five year site reviews are not required for OU 1.

- Operable Unit 2A (OU 2A) included surface soils and the solid waste contained in Landfill No. 1 and the Coal Ash and Drum Pile at Landfill No. 3 located in the southwest section of the base. The *OU 2A Record of Decision* (HAZWRAP, 1996) documented the remedy of Further CERCLA Action for OU 2A. Five-year site reviews are not required for OU 2A.

- Operable Unit 6 (OU 6) includes the source of contamination in surface and subsurface soils for the Railroad Maintenance Site, East Gate Waste Storage Tanks and Fuel Drop Site. Restoration activities at OU 6 have made the site available for unlimited use and unrestricted exposure. Five year site reviews are not required for OU 6.

- Operable Unit 7 (OU 7) includes the source of contamination in surface and subsurface soils and in sediments and surface water for the Quarry site. A removal action has been completed for source at OU 7 and the site was determined to be available for unlimited use and unrestricted exposure in the *First Five Year Review Report* (AFBCA, 2000). Five year site reviews are not required for OU 7.

- Operable Unit 7A (OU 7A) includes the source of contamination and addresses all media at the Receiver Site. In May 1995 the Receiver Site was removed from the CERCLA program and placed under the State of Maine regulations for underground storage facilities as specified in Code of Maine Rules Chapter 691, *Regulations for Registration Installation, Operation, and Closure of Underground Storage Facilities*.

Remedial Investigation (RI) and Feasibility Study (FS) Reports were prepared for each of these Operable Units. The RI/FS reports were utilized to develop RODs for the individual Operable Units. The RODs have become the controlling documents for site cleanup at the former Loring AFB.

5.1 REFERENCES

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September 2000.

FFA, 1995. Under CERCLA Section 120, The Matter of Loring Air Force Base by the U.S. Environmental Protection Agency Region I, State of Maine, and the U.S. Department of the Air Force; January 1991, amended December 20, 1993 and January 12, 1995.

HAZWRAP, 1996. *Operable Unit 2A Record of Decision*. Loring Air Force Base. March 1996.

6.0 REPORT SUMMARY

This section is included in this *Five-Year Review Report* to aid the reader in locating information specific to a particular Operable Unit.

6.1 MAPS

Two reference figures are included in this section. Figure 5-2 illustrates the Operable Units at the former Loring AFB. Figure 6.1-1 presents the locations of Operable Units, individual IRP sites, and land use parcels identified at the Former Loring AFB.

6.2 SUMMARY TABLE

Table 6.2-1 is provided as a reference for locating information on specific sites that were included in the Five-Year Review. Table 6.2-1 includes the following information:

Site I.D. – Specifies Operable Unit identifier used in the first *Five-Year Report* (AFBCA, 2000).

Sites Included – Lists individual sites included under the identifier in this *Five-Year Review Report*.

Site Categories – Indicates the category (Statutory or Policy) individual Operable Units were included in this *Five-Year Review Report*.

Location in Report – Indicates the report section where information for specific sites can be located.

6.3 REFERENCES

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September.

7.0 STATUTORY REVIEW SITES

7.1 MAP

The Statutory Review sites addressed in this *Five-Year Review Report* include Operable Units 2 and 4 (Landfills 2 and 3) and Operable Unit 3 (Contractor's Storage Shed, Explosive Ordnance Disposal Range and Outdoor Firing Range). The locations of these Operable Units and sites are illustrated in Figure 5-2.

7.2 FIVE-YEAR REVIEW OF STATUTORY REVIEW SITES

Individual subsections are provided to document the Five-Year Review process for each of the Statutory Review sites. These subsections are organized by Operable Unit/site identifier used in the first *Five Year Review Report* (AFBCA, 2000), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the *Comprehensive Five-Year Review Guidance* (EPA, 2001);
- Issues;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- References.

7.3 OPERABLE UNITS 2 AND 4, LANDFILLS 2 AND 3

7.3.1 Background

Operable Unit 2 (OU 2) is the management division for investigation and remedy selection for the soils/source component of Landfill 2 (LF 2) and Landfill 3 (LF 3). As shown in

Figure 7.3-1, both landfills are located in the western portion of the former air base. OU 2 deals directly with the landfill contents and their effect on human health and the environment. Operable Unit 4 (OU 4) is the groundwater component of LF 2 and LF 3.

7.3.1.1 Site Description

Landfill 2

LF 2 is located approximately one mile from the west gate on Nebraska Road and covers approximately 9 acres (see Figure 7.3-2). The LF 2 area was quarried for gravel during construction of the base. Waste disposal began in 1956 when the gravel supply had been exhausted. Wastes buried or burned at the site included domestic garbage, construction rubble, flightline wastes, and sewage sludge. Flightline wastes disposed in this landfill reportedly included oil, hydraulic fluids, solvents, thinners, and paints. LF 2 received waste from base activities until 1974.

The overburden geology at LF 2 is characterized as glaciofluvial, with associated deposits consisting of ablation till underlain by ice-contact deposits and a discontinuous layer of basal till. Bedrock is characterized as a dark gray, weathered, pelitic limestone. Overburden thickness ranges from negligible in the central area of the landfill to about 60 feet at the northwestern portion of the site, outside the area of landfilled wastes. In most cases, landfilled wastes were placed on ice-contact deposits; however, they were also placed directly on the bedrock surface in some areas.

Based on interpretive bedrock contours, it appears that a northwest to southeast trending bedrock trough exists beneath LF 2. The topographic high of the trough is located near the northwestern end of LF 3. The trough plunges northwest in the vicinity of LF 2 and influences groundwater flow in both the shallow bedrock and overburden soils. Groundwater flow at LF 2 is to the north-northwest, subparallel to the trend of the bedrock trough. Potentiometric head data for two overburden bedrock well pairs shows weak overall upward gradients in the area of LF 2.

Due to the permeable nature of the sand and gravel, and the weathered and fractured nature of the bedrock, the discontinuous shallow overburden aquifer and the fractured-bedrock

aquifer appear to form one groundwater system throughout the LF 2 area. The water table is located in the overburden soils over the majority of the LF 2 site. Therefore, it is assumed that groundwater comes into contact with some of the waste throughout the year (AFBCA. 2000).

Landfill 3

LF 3 is located approximately one-half mile from the west gate on Sawyer Road and covers approximately 30 acres (see Figure 7.3-2). Similar to LF 2, the site was mined for gravel during base construction activities and used as a landfill thereafter. LF 3 received residential, commercial, and industrial waste from base activities from 1974 to 1991.

LF 3 overburden geology is characterized as a former esker deposit, consisting of ablation till underlain by ice-contact deposits, and highly weathered, pellitic limestone. Thickness of the soils outside the landfilled material ranges from about 5 feet on the northern side to a maximum of 55 feet southeast of the site in the bedrock trough. Wastes appear to have been placed directly on the ice-contact sand and gravel deposits.

Bedrock in the LF 3 area is a gray pelitic limestone. The northwest-to southeast-trending bedrock trough present beneath LF 2 appears to continue beneath LF 3, narrowing and rising to a saddle in the northwestern area of LF 3, then deepening again to the southeast of the landfill. Bedrock is interpreted to be more fractured within the trough axis than on the trough walls.

The water table was typically encountered above the bedrock surface within the perimeter of LF 3 and the cap. The uppermost portion of LF 3 waste appeared to be seasonally saturated prior to capping. The groundwater system is bounded to the east and west of LF 3 by the bedrock trough, and data indicate that the water table enters bedrock in the axis of the trough south of LF 3. To the north of the divide, groundwater flows northward toward LF 2, whereas south of the divide, groundwater flow is interpreted to be southeast. Calculated vertical gradients suggest that downward groundwater movement exists on the flanks of the bedrock trough, and limited upward groundwater movement exists in the central areas of the bedrock trough (AFBCA, 2000).

7.3.1.2 Initial Response

In 1974, disposal of waste at LF 2 was discontinued and the area was covered with approximately 12 inches (in) of clean cover soil. In 1991 disposal of waste at LF 3 was discontinued and the area was covered with clean native soils similar to LF 2.

7.3.1.3 Basis for Taking Action

Site investigations at LF 2 and LF 3 were conducted beginning in 1985. The Final RI/FS for OU 2 was issued in 1994 (ABB Environmental Services, Inc. [ABB-ES], 1994). The Final RI for OU 4 was issued in 1995 (AFBCA, 2000). Results of the RIs are summarized below.

Landfill 2

Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, inorganics above background concentrations, total petroleum hydrocarbons (TPHs), and oil and grease were detected in groundwater in and around LF 2. In addition, several miscellaneous parameters, which are typical indicators of a plume of landfill-related groundwater contamination, were detected in groundwater samples collected in 1993 and 1994.

Contaminants detected in overburden wells inside the landfill perimeter include fuel-related VOCs and chlorobenzenes, SVOCs (including bis(2-ethylhexyl)phthalate [BEHP] above the Maximum Contaminant Levels [MCL]), pesticides, and inorganics. Concentrations of contaminants detected in perimeter wells completed in the overburden adjacent to or downgradient from LF 2 were generally lower than concentrations within the limits of the waste. No significant organic contaminants were detected in overburden groundwater in perimeter wells.

In bedrock monitoring wells around LF 2, inorganics above background concentrations were detected in all monitored wells. The SVOC BEHP was detected above the corresponding MCL. The VOCs vinyl chloride and tetrachlorethene (PCE) were detected above their State of Maine Maximum Exposure Guidelines (MEGs), but not in excess of their MCLs.

Landfill 3

VOCs, SVOC, pesticides, and inorganics above background concentrations were detected in groundwater in and around LF 3. Oil and grease were also detected in groundwater samples collected within the LF 3 boundary during sampling.

Within the LF 3 boundary, concentrations of VOCs (including benzene, trichloroethene [TCE], PCE, and vinyl chloride), SVOCs (including polynuclear aromatic hydrocarbons [PAHs]), and inorganics (including lead, nickel, and cadmium) were detected above MEGs and/or MCLs. The only exceedance for pesticides was heptachlor in a single well. Concentrations of VOCs, SVOCs, and inorganics are generally highest in wells within the southern half of the landfill.

VOCs (i.e., PCE, benzene, and vinyl chloride) were detected above the MEGs and/or MCLs in bedrock wells, generally south, east, and west of LF 3. SVOCs have been detected in several bedrock monitoring wells, however only BEHP concentrations were above MCLs or MEGs. No pesticides or Polychlorinated Biphenyls (PCBs) were detected above MEGs and/or MCLs in wells around LF 3. Inorganics above background concentrations have been detected in bedrock wells in the vicinity of LF 3.

7.3.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions performed at Landfills 2 and 3.

7.3.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Operable Unit 2 Record of Decision

The *OU 2 Record of Decision* (ABB-ES, 1994) outlined the selection of a source control remedy for OU 2.

Operable Unit 4 Record of Decision

The *OU 4 Record of Decision* (ABB-ES, 1996b) outlined the selection of a minimal action remedy for OU 4.

7.3.2.2 Remedial Action Objectives

Remedial Action Objectives (RAOs) were developed to serve as a framework for the identification of remedial action alternatives. According to the Federal and State guidance, RAOs should be designed to protect human health and the environment by identifying chemicals of concern (COC), receptor groups of greatest concern, exposure routes associated with the highest risk estimates, and a target risk level of the individual contaminants based on site specific exposure scenarios.

The RAOs for the soils/source (OU 2) component of LF 2 and LF 3 were:

- Soils/Landfill Contents - prevent dermal contact with and ingestion of contaminated landfill contents and soils.
- Air/Dust - prevent the migration and inhalation of fugitive dust and soil particles with adhering contaminants.
- Landfill Gas - prevent inhalation and explosion of landfill gases.
- Surface Water and Sediment - prevent ingestion, adsorption, and bioconcentration of contaminants in surface water and sediment.
- Leachate - minimize formation and migration of leachate to groundwater and surface water.

The RAOs for groundwater (OU 4) at LF 2 and LF 3 were:

- To prevent human exposure to contaminated groundwater.
- To protect downgradient groundwater from contamination.

7.3.2.3 Remedy Description

The OU 2 source control remedy included:

- Site preparation including consolidation of Loring AFB soils for subgrade and grading to minimize erosion and manage runoff.
- Multi-layer cover system installation which complies with RCRA Subtitle C and Maine hazardous waste requirements including landfill gas assessment and controls, and assessment of adjacent wetlands.
- Gates and warning signs installation.
- Deed restrictions on land in the vicinity of the landfills.
- Post closure monitoring and maintenance.
- Five-year site reviews.

The OU 4 minimal action remedy included:

- Implementation of institutional controls (ICs).
- Groundwater monitoring.
- Five-year site reviews.
- Contingency action, if necessary.

The *OU 4 Record of Decision* (ABB-ES, 1996b) established Action Levels for groundwater at Landfill 2 and 3. The OU 4 groundwater Action Levels are listed in Table 7.3-1.

7.3.2.4 Remedy Implementation

Cover Systems. The cover systems for LF 2 and LF 3 were designed to meet or exceed applicable Federal and State regulations, and in accordance with accepted engineering design practices. Site preparation for the LF 2 cover system began in 1994, and the cover system was constructed in 1996. Construction of the LF 3 cap was initiated in 1999 and completed in 2000 (AFBCA, 2000).

Documentation of project completion including record drawings is recorded in the *Final Remedial Action Report, Landfill 2 Cover System,* (Bechtel, 1997b).

The final cap at LF 3 was built in accordance with the *Construction of Landfill 3, Final Cap, Remedial Action Work Plan, Revision 2,* June (Bechtel, 1999). Documentation of project completion including record drawings is recorded in the *Landfill 3 Remedial Action Report,* (Bechtel, 2000).

Gates and Warning Signs. Gates were installed at all entrances (one at LF 3 and two at LF 2) to prevent vehicle access, and signs were installed in the spring of 2000.

Deed restrictions on land in the vicinity of the landfills. The ROD for OU 2 specifies the use of Landuse Controls/Institutional Controls (LUC/ICs) on the land in the vicinity of the landfills to limit subsurface development, use of the property, and excessive vehicular traffic. This includes land currently owned by the U.S. Fish and Wildlife Service (USFWS) and the University of Maine. Both landfills were transferred to USFWS by Transfer Agreement dated September 8, 1998. There is no deed for this Federal-to-Federal agency transfer. This agreement prohibits activities that will affect the OU 2 remedies. As required by the OU 4 ROD, a groundwater use restriction in the form of a Groundwater Management Zone (GMZ) was placed in the Transfer Agreement with the USFWS for all of their property. The transfer agreement strictly prohibits any activity on the refuge that would jeopardize the effectiveness of the remedy. A portion of this GMZ extends beyond the northern edge of LF 2 into property owned by the University of Maine. Groundwater use restrictions have been acquired and recorded for this property.

The LUC/ICs implemented for the Landfills are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

Monitoring and Maintenance. Since the last Five-Year Review, groundwater monitoring has been performed at LF 2 and LF 3 in accordance with the *Work Plan for Monitoring and*

Maintenance of Landfills (Bechtel, 1997a) and the *Post Closure Monitoring and Maintenance Plan (PCMMP), Revision 1* (MWH, 2003). This revision reduced the frequency of groundwater sampling at LF 2 from biannually to annually. LF 2 is sampled in the spring, and sampling at LF 3 is performed biannually in the spring and fall. Samples are analyzed for site specific COCs, total petroleum hydrocarbons, and miscellaneous landfill parameters including major and complex ions required by the *MEDEP Solid Waste Management Rules, Chapter 405*. Based upon historical data indicating no detections of cadmium, lead and zinc above their Action Levels since post-closure monitoring began in 1997, the recommendation to remove these metals from the OU 4 monitoring plan was made in the *2003 Annual Report* (MWH, 2004). The *PCMMP* also requires that samples from LF 2 and LF 3 compliance boundary wells are analyzed for a full suite of EPA priority pollutants for the CERCLA Five-Year Review process. These samples were collected during the spring 2005 sampling round. No organic or inorganic analytes were detected at concentrations above the Landfill 2 and Landfill 3 Action Levels listed in Table 7.3-1.

Groundwater monitoring data are presented to EPA and MEDEP biannually in data reports subsequent to each sampling event. Maintenance activities and results from visual inspections, settlement monitoring, groundwater and landfill gas monitoring as well as trend analyses have been presented annually in Maintenance and Monitoring Reports.

Five-Year Reviews. The *First Five-Year Review Report* was submitted in 2000 (AFBCA, 2000). As required by the OU 2 and OU 4 ROD, five-year site reviews are intended to evaluate whether the response action continues to protect human health and the environment, assess site conditions, and propose further actions, if necessary. This *Five-Year Review Report* is the second five-year review of the remedial action at Landfill 2 and 3.

Contingency Action. Groundwater monitoring conducted in 1997 and 1998 indicated contaminant concentrations in LF 2 and LF 3 compliance boundary wells in excess of the action levels established in the *OU 4 ROD*. In accordance with the *ROD*, a contingency action was implemented. As described in the *OU 4 and OU12 Explanation of Significant Differences* (AFBCA, 2001), the LF 2/LF 3 compliance boundary was extended to the north and south with the installation of three new compliance boundary wells. Figure 7.3-2

illustrates the updated compliance boundary. No compounds have been detected in excess of Action Levels at the new compliance boundary wells.

7.3.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for Landfill 2 and 3 remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- Establish new groundwater compliance and institutional control boundaries for OU 4.
- Continue to monitor and maintain the landfills in accordance with the *Post-Closure Plan, Operable Units 2 and 4 (OUs 2 and 4), Final,* February, 1997, (ABB-ES/ HAZWRAP, 1997).
- Base Realignment and Closure (BRAC) Cleanup Team (BCT) should evaluate frequency of specific M&M activities in accordance with recommendations in the annual reports.
- An institutional control should be implemented for property owned by the University of Maine north of LF 2.

The Air Force has successfully implemented the components of the remedy. The successful implementation of the remedy has been documented in the following reports:

- *Operable Unit 4 (Landfill 2 and 3 Groundwater) & Operable Unit 12 (Quarry Groundwater) Explanation of Significant Differences* (AFBCA, 2001)
- *2000 Annual Report, Monitoring and Maintenance of Landfills* (Montgomery Watson, 2001)
- *2001 Annual Report, Monitoring and Maintenance of Landfills* (MWH, 2002)
- *2002 Annual Report, Monitoring and Maintenance of Landfills* (MWH, 2003)
- *2003 Annual Report, Monitoring and Maintenance of Landfills* (MWH, 2004)

As noted above, LUC/ICs are in place for OU 4 within the Landfills GMZ in the form of the transfer agreement between the Air Force and USFWS and in restrictions in the deed that was executed between the Air Force and the University of Maine

The compliance boundary for OU 4 was expanded as documented in the *Operable Unit 4 (Landfill 2 & 3 Groundwater) & Operable Unit 12 (Quarry Plume) Explanation of Significant Differences* (AFBCA, 2001).

A Deed of Easement and Declaration of Covenant for the University of Maine property located north of LF 2 was finalized in September 2000. The document established a URZ for the property which incorporates the groundwater and land use restrictions associated with the Landfills GMZ.

7.3.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.3.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The source control remedy selected for OU 2 (cover installation and institutional controls) and the minimal action remedy selected for OU 4 (groundwater monitoring, contingency action and additional institutional controls) remain protective of human health and the environment.

7.3.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater remediation goals in the *OU 4 Record of Decision* were based on ARARs, except where ARARs were not available. Action levels for landfill related groundwater COCs at the Compliance Boundary are based on Federal Safe Drinking Water Act MCLs, the State of Maine MEGs, laboratory practical quantitation limits (PQLs) or human health based risk based calculations.

Of the action levels established for groundwater under the OU 4 long-term monitoring program, ARARs were used for all COCs except bis(2-ethylhexyl)phthalate, 4-Methylphenol, iron, lead, manganese and zinc. The Federal Safe Drinking Water Act MCL for bis(2-ethylhexyl)phthalate is below the laboratory PQL, and as such, the PQL serves as the action level. ARARs do not exist for 4-Methylphenol, iron and manganese, and as such, human health based risk calculations have been established as action levels. Action levels for lead and zinc are based upon human health based risk calculations. However, detections of lead and zinc have been well below both the MCL and the risk based action level since post-closure monitoring began in 1997. As a result, a recommendation was made in 2004 to remove these constituents from the OU 4 long-term monitoring program.

The ARARs for OU 4 remain current with the exception of arsenic. On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 µg/l to 10 µg/l). Groundwater monitoring during the OU 4 and 12 RI process included analysis for arsenic concentrations, and a background value of 2 µg/l was established for groundwater at the former Loring AFB (Harding Law Associates [HLA], 1999c). Detections of arsenic above the former MCL of 50 µg/l were limited and arsenic was determined not to be a COC for groundwater at the former Loring AFB.

A review of the historical data collected during the RI process indicates that detections above the new MCL of 10 µg/l are minimal and are limited to a couple of locations within the disposal areas of Landfills 2 and 3. Arsenic is not considered a chemical released to the environment during disposal activities at Landfill 2 and 3, but is more likely a byproduct of the breakdown of constituents disposed there. Elevated arsenic in groundwater beneath the footprint of the landfill waste disposal areas is considered to be the result of the natural degradation of the wastes within the landfill. The degradation of these wastes creates a reducing and low pH geochemical environment, thus increasing the mobility of inorganics, including arsenic.

It is expected that the OU 4 remedy will remain protective of human health and the environment with respect to arsenic with the institution of the new ARAR for arsenic. Long-term monitoring of groundwater and groundwater use restrictions protect receptors at

the compliance boundaries and restrict the usage groundwater within the GMZs. Should long-term monitoring of groundwater at the compliance boundary points indicate that elevated arsenic in groundwater is migrating offsite, the remedy for OU 4 would be revised to remain protective of human health and the environment.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Human health risk-based concentrations were used to establish remediation goals for 4-methylphenol, iron, lead, manganese, and zinc (see Table 7.3-1). Review of toxicity factors showed that the values have not changed since establishment of the remediation goals.

In addition to the constituents for which remediation goals were calculated, several others were identified as contaminants of potential concern (COPCs) in the human health risk assessment. In the time since remediation goals were first calculated, it is possible that changes in toxicity values for some COPCs may result in total estimated risk that exceeds the target risk level. Under that scenario, remediation goals for the additional specific COPCs may need to be developed. Therefore, toxicity factors for all COPCs identified in the risk assessment were evaluated to identify changes in values used in the risk assessment versus values currently available. Table 7.3-2 lists all COPCs identified in groundwater at the Loring Air Force Base for which toxicity factors have changed. Toxicity factors remain unchanged for all other COPCs not listed in Table 7.3-2.

Among the COPCs identified at OU4 (listed in Table 3-2 of the *Operable Unit 4 Feasibility Study* [ABB-ES, 1996a]), toxicity factors have changed for a number of COPCs. For carcinogenic risks remediation goals were developed for COPCs that contributed to a risk in excess of $1x10^{-6}$ (one in one million), leading to a total risk in exceedance of $1x10^{-4}$ (one in ten thousand), when contribution from all COPCs are considered. Therefore, carcinogenic risks did not exceed $1x10^{-6}$ for COPCs not listed in Table 7.3-2. Carcinogenic toxicity factors are linearly related to risk, i. e, increase in toxicity value results in an equal increase in risk. Therefore, any increase in carcinogenic toxicity factor that is less than 100, will not affect the cumulative target risk of $1x10^{-4}$.

Trichloroethene (TCE) is the only COPC for which the currently available carcinogenic toxicity factor is higher than that used during the risk assessment. Because the toxicity factor is higher by a factor of 40, estimated risk using the currently available toxicity factor will not significantly add to the total risk. Also, the toxicity factors for TCE have been withdrawn from EPA's Integrated Risk Information System (IRIS) database, and the new values have not been included. In addition, the remediation goal for TCE is based on the MCL, which has not changed. Therefore, remediation goals developed based on human health risk assessment remain protective.

For noncarcinogenic risks, currently available toxicity factors are lower (therefore, estimated risks will be higher) for chlordane, 2-methylnaphthalene, naphthalene, phenol, TCE, and xylenes. The calculated noncarcinogenic risks for these compounds were checked to determine the impact of currently available values. Estimated noncarcinogenic risks will not be impacted for all these compounds, with the exception of TCE, if currently available toxicity factors are used. Noncarcinogenic risks due to exposure to TCE will exceed a hazard quotient of one (HQ=1) at two areas, LF-3 overburden inside the landfill and LF-3 overburden groundwater, within OU 4 if current values are used. However, the remediation goal for TCE is based on the MCL, which has not changed. Therefore, changes in the TCE toxicity factor do not affect the remediation goal for this compound.

Several compounds currently have toxicity factors available, that were not available at the time of the risk assessment. These include n-nitrosodiphenylamine, and vinyl chloride. Again, estimated carcinogenic risks will not be impacted if currently available toxicity factors are used. The remediation goals listed in Table 7.3-1 are conservative and remain protective.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any

significant change in EPA guidance, which could result in significant revisions to the remediation goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to remediation goals.

Expected Progress Toward Meeting RAOs: Remedial action objectives associated with the source control remedy and groundwater remedy at LF 2 and LF 3 are currently being achieved.

7.3.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.3.4.4 Technical Assessment Summary

As described above, the remedies at OU 2 and OU 4 are functioning as intended by installation of the landfill cover systems, successful establishment of Groundwater Management Zones, groundwater-use restrictions, long-term maintenance and monitoring, and five-year site reviews. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, and no other information has come to light that would call into question the protectiveness of the remedy.

7.3.5 Issues

Based upon historical data indicating no detections of cadmium, lead and zinc above their Action Levels since post-closure monitoring began at LF 2 in 1997, the recommendation to remove these metals from the OU 4 monitoring plan was made in the *2003 Annual Report* (MWH, 2004).

7.3.6 Recommendations and Follow-up Actions

Routine long-term monitoring and reporting of groundwater under the Post-Closure Monitoring and Maintenance program should continue. Routine monitoring for OU 4 should also include monitoring of LUC/ICs to document their continued effectiveness.

7.3.7 Protectiveness Statement

The remedy selected for the Landfills 2 and 3 (source control and minimal action) remains protective of human health and the environment.

7.3.8 References

ABB Environmental Services, Inc.(ABB-ES). 1994. *Operable Unit 2 (OU 2) Record of Decision.*

ABB-ES. 1996a. *Operable Unit 4 (OU 4) Feasibility Study.* May.

ABB-ES. 1996b. *Operable Unit 4 (OU 4) Record of Decision.* September.

ABB-ES. 1997. *Post Closure Plan for Operable Units 2 and 4 (OUs 2 and 4)*. February.

AFBCA. 2000. *First Five-Year Review Report for Loring Air Force Base*. September.

AFBCA. 2001. *Operable Unit 4 (Landfill 2 and 3 Groundwater) & Operable Unit 12 (Quarry Groundwater) Explanation of Significant Differences*. January.

AFRPA, 2004. *Land Use Control/Institutional Control Management Plan, Loring Air Force Base, Maine.* October, 2004.

Bechtel Environmental, Inc. (Bechtel). 1997a. *Work Plan for Monitoring and Maintenance of Landfills.* April.

Bechtel Environmental, Inc. (Bechtel). 1997b. *Final Remedial Action Report, Landfill 2 Cover System.* May.

Bechtel. 1999. Construction of Landfill 3, Final Cap, Remedial Action Work Plan, Revision 2. June.

Bechtel. 2000. *Landfill 3 Remedial Action Report, Volume 1, Revision 0.* April.

EPA. 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

MWH Americas, Inc. 2003. *Post-Closure Monitoring and Maintenance Plan for Landfills, Revision 1*. June.

7.4 OPERABLE UNIT 3, CONTRACTOR'S STORAGE SHED AREA

7.4 1 Background

7.4.1.1 Site Description

Operable Unit 3 (OU 3) includes a number of the former debris disposal areas at the former Loring Air Force Base. OU 3 consists of 17 sites located throughout the former base area.

The Contractor's Storage Shed Area (CSSA) site is located in the south-central portion of Loring AFB (Figure 7.4-1). The CSSA is located in the northeast quadrant of the intersection of Weinman and Kansas Roads, west of the railroad tracks. A demolished storage shed (Building 7258) at the site was open on the east side facing the railroad tracks and flightline. The site is primarily covered with grass, except for a gravel area west of the former building location (Figure 7.4-2) (MWH, 2004). A drainage culvert is located on the northeastern side of the site, next to the railroad tracks, but has only intermittent flow following rain events or winter thaw.

The CSSA site historically served as an industrial waste handling area. The storage shed has since been removed. Prior to demolition of Building 7258, this site was used for storage and staging of electrical transformers, waste oil, and waste chemical drums.

The site was most recently used as a parking lot and storage area for grounds-keeping equipment. The future use of the site is expected to remain industrial and has been classified as airport-support property by the Loring Development Authority (LDA).

The suspected sources of contaminants at the CSSA site are spills which occurred during the handling of electrical transformers, waste oil, and waste chemical drums. Accidental releases in this area were reportedly witnessed by base personnel. Drums with location identifications that included Drum Storage, Stockroom 03B, and Buildings 7258, contributed to some of the spills. Pesticide mixing at the site was verbally reported, but has not been confirmed by written documentation. These accidental releases impacted surface and subsurface soils, sediments, and groundwater (AFBCA, 2000).

7.4.1.2 Initial Response

No remedial action was performed at CSSA prior to the finalization of the *Operable Unit 3 Record of Decision*, (Law Environmental [Law], 1996).

7.4.1.3 Basis for Taking Action

A Preliminary Assessment/Site Investigation (PA/SI) was completed for OU 3 in 1993 to evaluate the risk of 17 sites, including the CSSA, on human health and the environment. The results of the PA/SI indicated that a Remedial Investigation/Additional Site Assessment (RI/ASI) should be performed for the CSSA site. The RI/ASI indicated the presence of fuel related VOCs and SVOCs, PCBs and pesticides in surface and subsurface soils at the CSSA site as well as fuel related VOCs and SVOCs and pesticides in sediment along the railroad tracks at the site. A baseline risk assessment (RA) indicated an elevated risk to both human and ecological receptors from soils and sediment at the CSSA site (Law, 1996).

7.4.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe remedial actions at the CSSA site.

7.4.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Operable Unit 3 Record of Decision

The *Operable Unit 3 Record of Decision* (Law, 1996) documented the selection of a remedy to address the risk to human and ecological receptors presented by soil and sediment at the CSSA site. The remedy included the following components:

- Excavation of soils for which associated contamination exceeds the remediation goals, except chlordane-contaminated soils;
- Confirmation sampling to ensure soils exceeding the remediation goals, except chlordane-contaminated soils, have been excavated;
- On-base disposal of the excavated soils in Landfill 3;

- Placement of a 2-foot thick clean soil cover over the chlordane-contaminated areas, with proper erosion protection;
- Implementation of institutional controls, and
- Wastewater treatment if required.

7.4.2.2 Remedial Action Objectives

The excavation, removal and disposal of soils containing contaminants exceeding the remediation goals, and placement of the soil cover over the chlordane-contaminated soils are to protect against human exposure to the contaminated soils and prevent migration of contaminants to groundwater. The application of institutional controls are designed to protect against future human exposure to the chlordane-contaminated soils exceeding the remediation goals (Law, 1996).

The *Operable Unit 3 Record of Decision* (Law, 1996) identified the following RAOs for the CSSA site to be protective of human health:

- Reduce soil and sediment levels of systemic toxicants to equal background or a target hazard index of one (1) for individual constituents, with the cumulative target hazard index not to exceed 10 for the most exposed human receptor groups.
- Reduce soil and sediment levels of potential carcinogens to equal background or a target risk of $1x10^{-6}$ for individual constituents, with a cumulative risk of no greater than $1x10^{-5}$ for the total excess carcinogenic risk for the most exposed human receptor groups. The method detection limit is used as a goal when background and risk-based goals are below analytical limits.
- Reduce subsurface soil levels to levels that would be protective of groundwater quality.
- Control the migration of soil and sediment contamination to uncontaminated areas.

The CSSA soil remediation goals are summarized in Table 7.4-1.

7.4.2.3 Remedy Description

The selected remedy for the CSSA site involved the excavation, removal and land disposal of soils contaminated with PAHs, pesticides (except chlordane) and heavy metals at concentrations that exceeded the remediation goals (RGs) (Table 7.4-1). Chlordane-contaminated soils were to remain on site and be covered by a minimum of 2 feet of clean soil, with erosion protection, to prevent future exposure. ICs to identify the presence of chlordane at the site and to manage exposure to chlordane were established and are to be modified as necessary to ensure that they remain in place and effective.

7.4.2.4 Remedy Implementation

During 1997 approximately 2,500 cubic yards (cy) of contaminated soil were excavated, loaded into dump trucks and transported to Landfill-3 for disposal. 180 cy of chlordane contaminated soils were excavated and placed into adjacent excavations. As required by the ROD, two feet of non-chlordane contaminated soil cover was placed over the chlordane contaminated soils. In some instances, chlordane containing soil was placed into excavations to ensure that the final grade over the excavated areas matched the existing grades to avoid future grading and erosion (Law, 1996).

Confirmatory sampling was completed on all locations. Some re-excavation and re-sampling was performed until all test results showed compliance with the remediation goals identified in the *Operable Unit 3 Record of Decision* (Law, 1996).

LUC/ICs are in place for the CSSA site in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (LDA). As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the deed of transfer contains provisions restricting any activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact to the protectiveness of the remedial action.

The deed implemented several LUC/IC measures. These include a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or

elementary/secondary schools. Additional LUC/IC measures include a GMZ (GMZ 1) prohibiting use of groundwater. The deed established GMZ 1 as a URZ requiring concurrence from the Air Force for any digging, excavation or construction within the URZ.

The LUC/ICs implemented for the CSSA are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.4.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the RAOs for the CSSA site have been met and that the remedy selected for the CSSA site remains protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- The Air Force should assure transfer documents include restrictions which implement the OU 3 remedy and are consistent with the Record of Decision for the Disposal of Loring AFB, Maine, April 1994 and notify future landowners of potential chlordane presence.

The portion of the former Loring AFB in which the CSSA site is located was transferred to the LDA in December 2004 by quitclaim deed. As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the deed of transfer contains provisions restricting any activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact to the protectiveness of the remedial action.

The Air Force conducts periodic, informal, reviews of current landuse at Loring AFB and provides written notice annually to current landowners as a reminder of the existing LUC/ICs attached to their property.

7.4.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

7.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The remedy for the CSSA site, including excavation and disposal of contaminated soils above 2-feet bgs and the establishment of LUC/ICs restricting future use of the site, remain protective of human health and the environment.

7.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

The remediation goals established for the CSSA site were established to reduce hazard indices and carcinogenic risk to benchmark regulatory standards as well as to protect groundwater. Landuse at the CSSA site is consistent with the assumptions used during the evaluation of risks during the RAs. The LUC/ICs established in accordance with the *Operable Unit 3 Record of Decision* (Law, 1996) remain functional and have been included in the deed of transfer for the former Loring Air Force Base.

7.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.4.4.4 Technical Assessment Summary

The remedy at the CSSA site in OU 3 is functioning as intended. Soil containing chlordane above the remediation goals remains secured below two feet of clean soil at the site.

LUC/ICs are in place for the CSSA site in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (LDA) to further eliminate any potential exposure pathways to the chlordane contaminated soils. No changes in exposure pathways are affecting the protectiveness of the remedy. No other information has come to light that would call into question the protectiveness of the remedy.

7.4.5 Issues

No issues were identified for the CSSA site.

7.4.6 Recommendations and Follow-up Actions

Chlordane contaminated soil was excavated and placed on the site where it has more than two feet of cover to minimize the risk of erosion. While the chlordane identified in the Remedial Investigation did not present a future human health risk, its concentrations were above the risk based screening values developed at Loring AFB. Therefore, the Contract Storage Shed site does not meet the requirement for unrestricted use and unlimited exposure. Future Five-Year reviews are required to ensure that the remedy remains protective.

7.4.7 Protectiveness Statement

The remedy selected for the CSSA site under OU 3 remains protective of human health and the environment and is expected to be protective in the future, because exposure pathways to soil containing contaminants of concern have been eliminated.

7.4.8 References

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September 2000.

AFRPA, 2004. *Land Use Control/Institutional Control Management Plan, Loring Air Force Base, Maine.* October, 2004.

Bechtel, 1997. *Remedial Action Report for the Contract Storage Shed Area,* September 1997.

EPA, 1996. *Guidance for Evaluation of Federal Agency Demonstrations that Remedial Actions are Operating Properly and Successfully Under CERCLA Section 120(h)(3).* Interim. August 1996.

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

Federal Facility Agreement (FFA), 1995. *Under CERCLA Section 120, The Matter of Loring Air Force Base by the U.S. Environmental Protection Agency Region I, State of Maine, and the U.S. Department of the Air Force*; January 1991, amended December 20, 1993 and January 12, 1995.

Law Environmental (Law), 1996. *Operable Unit 3 (OU 3) Debris Disposal Areas Record of Decision,* September 1996.

MWH, 2004. *2003 Operable Unit 12 Annual Report, Loring Air Force Base, Limestone, ME.* April 2004.

7.5 OPERABLE UNIT 3, EXPLOSIVE ORDNANCE DISPOSAL RANGE AND OUTDOOR FIRING RANGE

7.5.1 Background

7.5.1.1 Site Description

Operable Unit 3 (OU 3) includes all of the former debris disposal areas at the former Loring Air Force Base. OU 3 consists of 17 sites located throughout the former base area.

Explosive Ordnance Disposal (EOD) Range

The EOD Range consists of two portions that total approximately 65 acres (Figure 7.5-1). The southern portion of the range (approximately 35 acres) is generally grass covered or barren. The remainder of the site, about 30 acres, is peripheral to the north and west of the open grassy area (Figure 7.5-2). This portion of the site is wooded and appeared to be an abandoned EOD Range based on the presence of warning signs and debris consistent with EOD operations, as observed during the site investigations (AFBCA, 2000).

The site was previously used for disposal of ammunition by detonation and burning, and for burial of munitions residue, spent cartridges, and construction debris. Ordnance disposal activities began in the southern area in the late 1960s. Activities were interrupted during the mid-1970s and resumed in the early 1980s until closure of the EOD range in 1988. Following closure, the site was used for mostly specialized training until closure of Loring AFB in September 1994. There are no records of use for the northern area of the site and it is believed to be an abandoned EOD range.

Outdoor Firing Range (OFR)

The OFR site is located in the east-central portion of the base (Figure 7.5-1). The range consisted of a small arms firing line, a skeet range, and a grenade range. The firing line faces east and is surrounded on three sides by an earthen berm and backstop. The area between the firing line and backstop is relatively flat and primarily grass covered (Figure 7.5-2).

7.5.1.2 Initial Response

Explosive Ordnance Disposal (EOD) Range

Limited removal actions in the form of ordnance clearing were conducted in 1997 and documented in the *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision* (HLA, 1998).

Outdoor Firing Range (OFR)

In 1995, as part of a base compliance project, approximately 600 cy of soil contaminated with lead bullets were removed from the backstop at the OFR site (Law, 1996). The soil was stabilized and disposed at an appropriate, permitted, off-base landfill.

7.5.1.3 Basis for Taking Action

Explosive Ordnance Disposal (EOD) Range

A PA/SI was completed for OU 3 in 1993 to evaluate the risk of 17 sites, including the EOD Range, on human health and the environment. The results of the PA/SI indicated that a RI/ASI should be performed for the EOD Range. Sampling performed at the EOD Range site during the RI/ASI indicated the presence of low concentrations of volatile and semi-volatile organic contaminants as well as metals and other explosive-related compounds in site soil.

Outdoor Firing Range

During the isolated removal performed in 1995, background soil samples were found to contain lead at concentrations above the Site background levels. The *Operable Unit 3 Record of Decision* (Law, 1996) determined that further investigation of the OFR site was necessary.

Supplemental Site Investigations identified lead-contaminated surface soil in front of and behind the small arms firing line. The affected area was determined to be approximately one-third acre in size. A RA indicated that lead concentrations observed in soil do not pose

an unacceptable level of risk to future human receptors and the small size of the affected area limits the impact of contamination on ecological receptors to acceptable levels (URS, 1998).

7.5.2 Remedial/Removal Actions

The following subsections describe remedial actions at the EOD Range and the OFR.

7.5.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Operable Unit 3 Record of Decision

A remedy was not selected for the EOD Range and OFR site in the *Operable Unit 3 Record of Decision* (Law, 1996). The *OU 3 Record of Decision* recommended the completion of further investigation of both sites.

No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision

Explosive Ordnance Disposal (EOD) Range

The *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision* (HLA, 1998) documented a remedy of no further CERCLA action for the EOD Range.

Outdoor Firing Range

The *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision* (HLA, 1998) documented a remedy of no further CERCLA action for the OFR.

7.5.2.2 Remedial Action Objectives

RAOs were not established under CERCLA for the EOD Range or the OFR since no unacceptable risk to human health or the environment was identified in the *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision* (HLA, 1998).

7.5.2.3 Remedy Description

A remedy of no further CERCLA action was documented for both the EOD Range and the OFR in the *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision* (HLA, 1998).

7.5.2.4 Remedy Implementation

Explosive Ordnance Disposal (EOD) Range

The Supplemental RI/ASI Technical Report (URS, 1998) recommended No Further CERCLA Action for soil in the EOD Range site based on the human health and ecological RA determination of no unacceptable risk. This conclusion was based on the projected future use of the site as a conservation area. To prepare the site for reuse as a conservation area, the Supplemental RI/ASI Technical Report recommended that the range be cleared of any potentially unsafe EOD-related residuals. Clearing of ordnance from this site began in the fall of 1997 and was completed in 1999. Clearance in accordance with Department of Defense Explosive Safety Board procedures was provided in January 2000.

The EOD Range has been transferred to the USFWS and is now part of the Aroostook National Wildlife Refuge. There is no deed for this Federal-to-Federal agency transfer. However, as necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the transfer agreement contains provisions restricting any activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact to the protectiveness of the remedial action.

Several LUC/IC measures have been implemented for the EOD Range including the establishment of a URZ prohibiting landuse incompatible with the established use as a wildlife refuge. Residential use and establishment of child care facilities, playgrounds or elementary/secondary schools is prohibited. The LUC/IC measures require concurrence from the Air Force for any digging, excavation or construction within the URZ.

The LUC/ICs implemented for the EOD Range are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

Outdoor Firing Range

The *Supplemental RI/ASI Technical Report* (URS, 1998) identified lead-contaminated surface soil in front of and behind the small arms firing line. The affected area was determined to be approximately one-third acre in size. A RA indicated that lead concentrations observed in soil do not pose an unacceptable level of risk to future human receptors and the small size of the affected area limits the impact of contamination on ecological receptors to acceptable levels (URS, 1998). This conclusion was based on the projected future use of the site continuing as a firing range.

The OFR has been transferred to the Army National Guard (Army) to be used for small arms training. The Maine Army National Guard (MEARNG) is currently using the property as an OFR. The transfer agreement between the Air Force and the Army requires the Army to mitigate environmental contamination requiring response actions that is attributable with that activity.

Several LUC/IC measures have been implemented for the OFR including the establishment of a URZ prohibiting landuse incompatible with the established use as an outdoor firing range. The URZ prohibits both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The property is now in the stewardship of the Army and operated as a firing range by the Maine Army National Guard. Prior to any change in land use the Army would be required to evaluate its condition in accordance with CERCLA and implement appropriate cleanup actions or additional land use restrictions.

The LUC/ICs implemented for the OFR are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and

this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.5.3 Implementation of Recommendations From Previous Five-Year Review

The first *First Five-Year Review Report* (AFBCA, 2000), concluded that the landuse assumptions supporting the No Further CERCLA Action decisions for these sites remained valid and the remedy remains protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- Air Force continue to review land use at these sites to assure consistency with assumptions made in the NFA decision.

The Air Force conducts periodic, informal, reviews of current landuse at Loring AFB and provides written notice annually to current landowners as a reminder of the existing LUC/ICs attached to their property.

7.5.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

7.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The No Further CERCLA Action decisions for these sites are based on the assumptions that future use of the EOD Range and OFR will be as a wildlife management area and military training area. The current landuse of these areas remains consistent with these assumptions, and the remedy remains protective of human health and the environment.

7.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Since No Further CERCLA Action was warranted for the EOD Range and OFR based on projected future uses of the sites, no ARARs were evaluated in the *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision* (HLA, 1998). The physical and landuse conditions evaluated in the *Supplemental RI/ASI Technical Report* (URS, 1998) remain unchanged.

7.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.5.4.4 Technical Assessment Summary

The No Further CERCLA Action decisions for these sites are based on the assumptions that future use of the EOD Range and OFR will be as a wildlife management area and military training area. The current landuse of these areas remains consistent with these assumptions, and the remedy remains protective of human health and the environment. Based on residual chromium concentrations at the EOD Range and residual lead concentrations at the OFR, these sites are not acceptable for unlimited use and unrestricted exposure.

7.5.5 Issues

No issues were identified for the EOD Range and the OFR site.

7.5.6 Recommendations and Follow-up Actions

Based on residual chromium concentrations at the EOD Range and residual lead concentrations at the OFR, these sites are not acceptable for unlimited use and unrestricted

exposure. The Air Force should continue to review land use at these sites to assure consistency with assumptions made in the no further action (NFA) decision.

7.5.7 Protectiveness Statement

The remedy selected for the EOD Range and the OFR site under OU 3 remains protective of human health and the environment and is expected to be protective in the future.

7.5.8 References

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September 2000.

AFRPA, 2004. *Land Use Control/Institutional Control Management Plan, Loring Air Force Base, Maine.* October, 2004.

EPA, 2001. *Comprehensive Five-Year Review Guidance,* EPA 540-R-01-007.

HLA, 1998. *No Further CERCLA Action for Sites Within Operable Units 3, 5, 10, and 11, Record of Decision,* July.

Law, 1996. *Operable Unit 3 (OU 3) Debris Disposal Areas Record of Decision,* September 1996.

URS, 1998. *Supplemental RI/ASI Technical Report, Explosive Ordnance Disposal (EOD) Range and Outdoor Firing Range,* January 1998.

8.0 POLICY REVIEW SITES

8.1 MAP

The Policy Review sites addressed in this *Five-Year Review Report* include OU 5 (Former Jet Engine Test Cell), OU 8 (Fire Training Area), OU 9 (Auto Hobby Shop), OU 10 (Entomology Shop/Jet Engine Buildup Shop), OU 11 (Base Laundry), OU 12 (Basewide Groundwater) and OU 13 (Surface Water, Sediment and Fish Tissue). The locations of these Operable Units and sites are illustrated in Figure 5-2.

8.2 FIVE-YEAR REVIEW OF CATEGORY 2 SITES

Individual subsections are provided to document the Five-Year Review process for each of the Policy Review sites. These subsections are organized by Operable Unit/site identifier used in the first *Five Year Review Report* (AFBCA, 2000), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the Comprehensive Five-Year Review Guidance (EPA, 2001);
- Issues;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- References.

8.3 OPERABLE UNIT 5, FORMER JET ENGINE TEST CELL

8.3.1 Background

8.3.1.1 Site Description

The former Jet Engine Test Cell (FJETC) facility, Building 8450, was built in 1957 and occupied approximately 1.2 acres on the east side of Oklahoma Road in the north-central portion of LAFB (Figure 8.3-1). All that presently remains at the FJETC site is a 40-foot by 55-foot concrete pad, some asphalt pavement, and a cobble-lined blast zone trough (Figure 8.3-2).

During the facility's use, jet engines were mounted on reinforced concrete pedestals in Building 8450 and various tests were performed during engine operation. The engine exhaust was directed southward down a blast zone trough located adjacent to the test cell. Jet fuel (JP-4) was stored in a 2,500-gallon aboveground storage tank (AST) near building 8450. A hydraulic oil tank, a lubrication oil tank, and an air tank (ASTs with unknown volumes) were located inside of Building 8450. Ancillary equipment included underground fuel lines, underground electrical conduits, and at least one floor drain. The Air Force decommissioned the FJETC in 1976 and demolished structures at the site in 1986. All ASTs at the FJETC were removed at this time. All that remains of the original facility is a concrete pad, some asphalt pavement, and the cobble-lined blast zone trough.

Operations at the FJETC generated JP-4 jet fuel, lubrication oils, hydraulic fluids, wash water, and engine coolants as liquid waste streams. Waste fluids, except for wash water, were drummed and sent to the Defense Reutilization and Marketing Office (DRMO) for disposal. The likely sources of contamination at the site include the former AST, spills or releases of waste fluids resulting from past site activities, and the potential leaching of contaminants into the subsurface soils in the blast zone by infiltration of precipitation (AFBCA, 2000).

The geology at the FJETC consists of an unconsolidated glacial till layer that is 32.5 to 45 feet thick underlain by bedrock. The unconsolidated glacial till is made up of varying amounts of sand, gravel, and cobbles with silt. Shallow soils in the immediate area of the

concrete slab and blast zone trough consist of fill. This fill is reworked native till mixed with some sand and gravel. The bedrock beneath the FJETC is argillaceous limestone that is folded, fractured, faulted, and weakly metamorphosed.

A perched groundwater condition exists at the FJETC. The perched groundwater is believed to be a result of groundwater from infiltration within the relatively permeable fill materials overlying the less permeable glacial till deposits. The groundwater flow direction within the overburden is to the west, but flow in the bedrock is to the southeast (MWH, 2004a).

8.3.1.2 Initial Response

Because of the potential risks to human health, an EE/CA and a an Action Memorandum were prepared for the FJETC site recommending a bioventing system to treat an approximately 0.5-acre area of soil contaminated with fuel-related compounds and low concentrations of chlorinated solvents (AFBCA, 2000).

In 1995, the bioventing system was installed. The system includes 13 air injection wells (AIW) and seven soil gas monitoring points. Following installation of the bioventing system, a 30-day testing period was initiated during which the system performance was monitored. As a result of this initial performance testing period, the final inspection of the bioventing system was performed and the system was certified operational and functional in the *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report* (Bechtel, 1996).

Confirmation soil sampling was conducted at the FJETC in 1998 and as a result, the area of known contamination and system was expanded to the west. To address this area, a new AIW (AIW101) was installed in January 1999. The *Biovent Sites Confirmation Sampling Field/Laboratory Results and Recommendations* (Bechtel, 1999) recommended that surface water management practices (e.g., trench excavation with sump or site grading and low-permeability cover) be implemented at the FJETC site in an attempt to lower the perched groundwater levels, which hampered the effectiveness of the system. Dewatering trenches were installed in July 1999.

8.3.1.3 Basis for Taking Action

During SI and RI activities conducted at the FJETC site between 1991 and 1994, 28 TerraProbe explorations and 13 soil borings were completed to characterize the nature and distribution of soil contamination at the site. Several monitoring wells were also installed; however, groundwater associated with the site is being addressed in accordance with OU 12, and is not discussed in this section of the *Five-Year Review Report*. The RI identified contaminated soils at the site that contain elevated levels of primarily fuel-related VOCs and SVOCs; however, low concentrations of chlorinated VOCs were also detected (AFBCA, 2000).

Soil contamination at the FJETC was generally located within a 125-foot radius of the test pad. Benzene, toluene, ethylbenzene, and xylene (BTEX) and two SVOCs (naphthalene and 2-methylnaphthalene) were detected throughout an area located within a 50-foot radius of the test pad and within the blast zone. The depth of contamination in this area ranged from ground surface down to bedrock. Concentrations of BTEX in subsurface soils ranged from not detected to 330 mg/kg. The highest concentrations of BTEX were generally located at a depth of approximately 5 feet to 8 feet bgs. Concentrations of chlorinated VOCs in subsurface soils ranged from not detected to 36 mg/kg. TPH contamination in subsurface soils was detected at depths ranging from 4 feet to 30 feet bgs with the highest concentration of 4,400 mg/kg being detected at 10 feet bgs (MWH, 2004a).

8.3.2 Remedial/Removal Actions

The following subsections describe remedial actions at FJETC.

8.3.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Sites Within OUs 5, 8, 9, 10 and 11 Record Of Decision

The *Sites Within OUs 5, 8, 9, 10 and 11 Record of Decision* (HLA, 1999) documented the selection of a remedy that included continued operation of the bioventing system at the FJETC site to continue to address the petroleum- and solvent-contaminated subsurface soils.

8.3.2.2 Remedial Action Objectives

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial objectives were developed in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). These remedial objectives were developed to mitigate existing and future potential threats to public health and the environment. The general RAOs relevant to the FJETC identified in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) are stated as follows:

1. Prevent human exposure (i.e., ingestion, inhalation, and dermal contact) to contaminated soil with concentrations in excess of remediation goals.
2. Prevent ecological exposure (i.e., ingestion, inhalation, and biological uptake) to contaminated soil with concentrations in excess of remediation goals.
3. Prevent contaminated soil with concentrations in excess of remediation goals from migrating to groundwater.

8.3.2.3 Remedy Description

The chosen remedy for FJETC as described in the *ROD* included the continued operation, performance monitoring and data reporting for the bioventing system until the risk-based remediation goals are achieved, allowing for unlimited use of the site and unrestricted exposure.

Contaminants of concern and site-specific remediation goals were developed for FJETC in the EE/CA and were included in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). In the development of remediation goals for FJETC, human health and ecological risk-based values were calculated and soil leaching model values were calculated. The site-specific remediation goals for FJETC represent the most stringent of these values. The FJETC remediation goals are listed in Table 8.3-1.

The chosen remedy for FJETC as described in the *ROD* also included performing Five-Year site reviews until the levels of contaminants remaining at the site allow for unlimited use and unrestricted exposure.

8.3.2.4 Remedy Implementation

Based upon the recommendations of the EE/CA and the Action Memorandum, the bioventing system was installed at the FJETC site in 1995. The chosen remedy for FJETC documented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) was the continued operation of the biovent system. The system was certified operational and functional in the *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report* (Bechtel, 1996).

Recommendations in the *2001 Annual Performance Report* (MWH, 2002b) included testing and, if successful, subsequent installation of deep AIWs to better distribute oxygen in the subsurface. A *Field Work Notification (FWN) for Former Jet Engine Test Cell (FJETC) Deep Air Injection Wells,* was submitted to EPA and MEDEP in August 2002. Based upon this FWN, a successful test was completed and 8 new AIWs were installed in September 2002: AIW-2D, AIW-3D, AIW-4D, AIW-8D, AIW-9D, AIW-10D, AIW-12D, and AIW-101D. The 8 new AIWs were installed with 5-foot screens to a depth ranging from 17 to 19 feet. Design airflow rates for these wells were 3 times greater than the shallow wells, or 10 standard cubic feet per minute (scfm). Current operation of the deep wells is continuous; however, operation of the shallow wells is pulsed monthly between the even and odd numbered shallow AIWs. Target airflow rates for the shallow wells were increased from 3 scfm to 5 scfm. The operational modes are now biosparge and bioventing when the deep wells are saturated, and bioventing when all well screens are exposed. The deep wells and increased airflow rates are providing additional oxygen for a greater percentage of the year, which is expected to increase the overall biodegradation rates.

The FJETC system was determined to be operating as designed in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004a). Annual confirmation soil sampling is performed to monitor remedial progress at the site and has shown that the deep injection wells have had some success at the FJETC site, however portions of the site still remain above the RGs. Soil sampling will continue until results indicate that the site has achieved RGs and is suitable for unlimited use and unrestricted exposure.

LUC/ICs are in place for FJETC in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property LDA. As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the deed of transfer contains provisions restricting any activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact to the protectiveness of the remedial action.

The deed implemented several LUC/IC measures. These include general provisions allowing for the Air Force continued operation of the biovent system in the future including right of access to conduct, operate, maintain or undertake any remedial action required under the Loring IRP. Additional LUC/IC measures include a URZ prohibiting any subsurface excavating, digging, drilling, subsurface construction or other disturbance of the surface without notice to and written approval of the Air Force.

The LUC/ICs implemented for FJETC are monitored maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

8.3.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for FJETC remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- The Air Force should evaluate the impact of the dewatering trench on the effectiveness of the FJETC biovent system;
- Perform annual system performance reviews, including collection and analysis of soil samples to monitor progress toward RGs; and
- If little change is noted in treatment effectiveness, alternate remedial alternatives should be considered.

The dewatering trench was first documented as positively impacting the performance of the bioventing system in the *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001* (MWH, 2002a). Subsequent annual evaluations of the dewatering trench performance were documented in the associated Annual Performance Reports listed above.

Annual evaluation of system performance including the collection of confirmation soil samples, progress toward RGs, and optimization efforts were documented in the following:

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001* (MWH, 2002a)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2001 – February 2002* (MWH, 2002b)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2002 – February 2003* (MWH, 2003)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2003 – December 2003* (MWH, 2004b)

This *Five-Year Review Report* documents the second review for the FJETC site under OU 5 source control.

8.3.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.3.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

As documented in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004a) the chosen remedy is protective of

human health and the environment and facilitating the attainment of RAOs. While the soil RGs at the FJETC site have not been met, mass destruction is ongoing.

8.3.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: ARARs do not exist for soil at FJETC. Site-specific, risk-based remediation goals were developed during the EE/CA and RI considering both current and projected future land use at FJETC. The RGs represent the most stringent value of human health and ecological risk-based values as well as soil leaching model results.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Remediation goals that are protective of human health and the environment were established based on the USEPA and MEDEP Risk Assessment Guidance and the *LAFB Risk Assessment Methodology* (HAZWRAP, 1994). Human health remediation goals were calculated using a $1x10^{-6}$ risk level for carcinogens and a hazard index (HI) of one for noncarcinogens. Ecological remediation goals were developed by back-calculating the ecological models to obtain soil concentrations that would result in a HQ of one. Soil leaching model results were used to develop soil remediation goals that would result in groundwater at concentrations less than the Federal Safe Drinking Water Act MCLs or the MEGs.

Remediation goals were established for benzene, methylene chloride, TCE, Toluene, xylene, 1,2-dichloroethane, naphthalene, and TPH at the FJETC in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). Current available human health toxicity factors for benzene, naphthalene, TCE, and xylene are higher than those used in the risk assessment (See Tables 7.3-2 and 8.3-2). However, carcinogenic risks from exposure to these chemicals did not exceed $1x10^{-6}$. Remediation goals were selected because of presence of TPH in soil and potential adverse effect on groundwater quality at FJETC, and were not selected for FJETC

based on results of human health and ecological risk assessments. Therefore, changes in toxicity factors do not affect the remediation goals applied to the FJETC site.

In addition to the constituents for which remediation goals were calculated, several others were identified as COPCs in the human health risk assessment. It is possible that changes in toxicity values for some COPCs since the original calculations may result in total estimated risk that exceeds the target risk level. Therefore, toxicity factors for all COPCs were evaluated during the five-year review process to identify changes in values used in the risk assessment versus values currently available. Tables 7.3-2 and 8.3-2 list all COPCs identified in soil at FJETC for which toxicity factors have changed. Toxicity factors remain unchanged for all other COPCs not listed in Tables 7.3-2 and 8.3-2.

Among the COPCs identified at FJETC, toxicity factors have changed for a number of COPCs. However, estimated risks using currently available toxicity factors will not significantly add to the total risks. In addition, several compounds currently have toxicity factors available, that were not available at the time of the risk assessment. Estimated risks due to exposure to these compounds is not be significant if currently available toxicity factors are used.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any significant change in EPA guidance, which could result in significant revisions to the remediation goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to remediation goals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy for FJETC is expected to meet each of the RAOs, based on observed decreasing contaminant concentration trends of COCs in soil.

8.3.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.3.4.4 Technical Assessment Summary

As described above, the remedy at FJETC is functioning as intended by successful operation, monitoring and reporting of the bioventing system, as well as conducting five-year site reviews. While the soil RGs at the FJETC site have not been met, mass destruction is still occurring. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, and no other information has come to light that would call into question the protectiveness of the remedy.

8.3.5 ISSUES

No issues were identified for the FJETC site.

8.3.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine annual system performance reviews and confirmation soil sampling should continue. Routine monitoring for FJETC should also include monitoring of LUC/ICs to document their continued effectiveness.

8.3.7 PROTECTIVENESS STATEMENT

The remedial action at FJETC in OU 5 (operation of the biovent system; implementation of LUC/ICs; and five-year site reviews) is protective of human health and the environment, and will remain so in the future as soil remediation goals are achieved.

8.3.8 REFERENCES

AFBCA, 2000. *First-Five Year Review Report, Loring Air Force Base, Limestone, ME.* September.

AFRPA, 2004. *Land Use Control/Institutional Control Management Plan, Loring Air Force Base, Maine.* October, 2004.

Bechtel, 1996. *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report*; Final; prepared for Department of the Air Force; Oak Ridge, Tennessee; April 1996.

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EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

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HAZWRAP, 1994. "Loring Air Force Base Risk Assessment Methodology"; Final; Environmental Restoration and Waste Management Programs; Oak Ridge, Tennessee; August 1994.

HLA, 1999. *Sites within OUs 5, 8, 9, 10 and 11 Record of Decision*; Installation Restoration Program; Loring Air Force Base; September 1999.

MWH 2002a. *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001*, Loring Air Force Base, Limestone, ME. February.

MWH 2002b. *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2001 – February 2002*, Loring Air Force Base, Limestone, ME. June.

MWH 2003. *Bioventing and Soil Vapor Extraction at Ous 5,8,9,10, and 11, Annual Performance Report, March 2002 – February 2003*, Loring Air Force Base, Limestone, ME. July.

MWH, 2004a. *Auto Hobby Shop, Jet Engine Build-up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites, Demonstration of a Remedial Action Operating Properly and Successfully, former Loring Air Force Base, Limestone, ME.* July 2004.

MWH 2004b. *Bioventing and Soil Vapor Extraction at OUs 5,8,9,10, and 11, Annual Performance Report, March 2003 – December 2003,* Loring Air Force Base, Limestone, ME. July.

USEPA, 1996. *Guidance for Evaluation of Federal Agency Demonstrations that Remedial Actions are Operating Properly and Successfully Under CERCLA Section 120(h)(3).* Interim. August 1996.

8.4 OPERABLE UNIT 8, FIRE TRAINING AREA

8.4.1 Background

8.4.1.1 Site Description

The Fire Training Area (FTA) is located east of the runway in the northeast portion of the base south/southwest of Oklahoma Road (Figure 8.4-1). The FTA occupies approximately 12 Acres. The terrain is open and well drained. Prior to remedial action the site consisted of a mock aircraft located in a circular pit that drained to an oil water separator (OWS). Figure 8.4-2 shows the prominent features of the FTA site.

The FTA was used from 1952 to 1988 for fire training activities. During training exercises, waste fluids consisting of fuels, oils, and solvents were released into the pit, ignited and extinguished. In 1981, a bentonite liner was added to the pit, a berm was constructed around the pit, and a UST and OWS were installed. Unburned fluids were piped to the OWS, with fuel product diverted to the UST and water diverted to a ditch on the north side of the FTA Access Road. A UST, located west of the pit, was reportedly used to store flammable liquids prior to use in the fire training pit. The USTs and associated piping were removed in 1994.

The likely sources of contamination at the FTA site include the release of waste fluids to the FTA pit during training exercises, the USTs, and the OWS. These areas cover approximately 4 acres of the central portion of the FTA site (AFBCA, 2000).

The geology underlying the FTA consists of glacially-derived soil overlying bedrock. Overburden soil consists of approximately 10 feet of fill (excavated and backfilled basal till around the FTA pit) and dense basal till consisting of brown to olive silty sand and sandy silt in other areas of the site. Bedrock is gray to bluish gray, layered, pelitic limestone ranging in depth from approximately 10 to approximately 20 feet bgs from southwest to northeast across the site, respectively. Groundwater at the FTA, for the most part, only occurs in the bedrock. Groundwater in bedrock is transmitted primarily through secondary porosity features such as fractures and along bedding planes (ABB, 1995).

8.4.1.2 Initial Response

The RI was completed for OU 8, including the FTA, in 1995. Based upon the findings of the RI, interim measures were taken to address contaminated soils and light non-aqueous phase liquid (LNAPL) fuel product contained within the fractured bedrock.

Soils

An EE/CA was prepared for the site recommending a combination of bioventing and excavation of contaminated soil with disposal at LF 3 (URS, 1995). Removal actions were conducted at the FTA between 1995 and 1999. In 1995, the oil/water separator and several areas of contaminated soil were excavated and the contaminated soil was disposed of at LF 3. Site-specific, risk-based remediation goals developed for the EE/CA were met by excavating 4,510 cy of soil (Bechtel, 1996a).

A bioventing system was also installed in 1995 in the vicinity of the pit and discharge pipeline. The final inspection of the bioventing system installation was performed in early spring of 1996, and the system was certified operational and functional (Bechtel, 1996b). The bioventing system operated until 1998, when soil confirmation sampling was conducted. Xylene, naphthalene, and 2-methylnaphthalene were detected at concentrations above the EE/CA developed remediation goals. Based on the confirmation sampling results, the bioventing system was decommissioned and approximately 23,100 cy of contaminated soil were excavated and disposed of at LF 3 (Bechtel, 1999 and JTL, 1999). Based on 1998 test pit and post-excavation soil confirmation sampling results, approximately 4,650 cy of fuel-contaminated soil were excavated in an area northwest of the former pit in 1999 and the excavated soil was disposed of at LF 3 (AFBCA, 2000).

LNAPL Product Recovery

In 1995, a product recovery pilot study was initiated to evaluate the feasibility of recovering free product from the shallow bedrock aquifer at the FTA site. The pilot study included a blast fractured bedrock recovery trench downgradient of the free product source area, extraction wells, and a groundwater treatment facility. Treated groundwater was discharged to surface drainage. The recovery trench and extraction wells created a capture zone for

product; however, an insufficient quantity of product accumulated to facilitate recovery from the bedrock trench.

8.4.1.3 Basis for Taking Action

The RI identified primarily fuel-related VOCs and SVOCs, as well as TPH, in surface and subsurface soils at the site. However, low concentrations of chlorinated VOCs were also detected. An area of fuel product in the shallow bedrock was also identified at the FTA site.

8.4.2 Remedial/Removal Actions

The following subsections describe remedial actions at FTA.

8.4.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Sites Within OUs 5, 8, 9, 10 and 11 Record Of Decision

The *Sites Within OUs 5, 8, 9, 10, and 11 ROD* (HLA, 1999) documented the response action for the FTA site of No Further Action for surface and subsurface soils (HLA, 1999). No Further Action was established for the soils at FTA because the contaminated soils were removed during initial response actions conducted in 1999. These removal activities were conducted prior to the finalization of the *ROD* resulting in acceptable risk levels for the soils at the site (based on unlimited use and unrestricted exposure).

However, because free fuel product was still present in the shallow bedrock, the FTA site was not available for unlimited use and unrestricted exposure. Therefore, the *ROD* also documented the remedy for FTA to include the passive recovery of free product to be performed by systematic removal of product from individual monitoring wells at the site using bailer or skimmer pumps. The Product Recovery portion of the FTA remedy includes the following components:

- *Product recovery;*
- *Product disposal; and*
- *Five-year site reviews.*

8.4.2.2 Remedial Action Objectives

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial objectives were developed in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). These remedial objectives were developed to mitigate existing and future potential threats to public health and the environment. No chemical or location specific ARARs were identified for recovery of product at FTA. Consequently, media-specific remediation goals were identified for FTA in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999).

The *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) identified the following specific RAO relevant to FTA:

- *Recover LNAPL from the aquifer at the FTA site to remove a continual source of groundwater contamination.*

8.4.2.3 Remedy Description

The remedy for FTA includes the passive recovery of fuel product performed by routine monitoring and removal of product (when encountered) from individual monitoring wells using bailer or skimmer pumps. The recovered product is placed in appropriate containers and transported off-site to an appropriate treatment or disposal facility.

8.4.2.4 Remedy Implementation

Product monitoring has been ongoing at the FTA site since the beginning of the pilot study program in 1995. The passive LNAPL product recovery remedy documented by the *ROD* was performed monthly at the FTA through December 2003. As indicated in the *Fire Training Area Remedial Action Completion Report* (MWH, 2005), product has been recovered from only three wells at the site: URS-4, JPZ-1141 and JPZ-1184. Most of the product recovered at FTA was recovered by the end of 1999 (2 liters). Recovery during the following years has decreased substantially with only one year of significant recovery (2001) of 0.5 liters.

The original estimate of product volume at the site was 1,000 gallons as stated in the *FTA Pilot Study Report* (URS, 1999). The original product estimate was based on an equivalent porous media model and included an upper limit of 8,000 gallons and a lower limit of 125 gallons, showing the large variability involved in the calculations. Assumptions were made for this calculation based on factors including interpreted distribution of free product, estimated fracture porosity and product thickness measured in the recovery wells. Maine Department of Environmental Protection prepared a memorandum that estimated the residual contamination volume at 1800-14,000 liters (approximately 500-3,700 gallons) based on a residual contaminant saturation model (MEDEP, 2005). Passive product recovery efforts at FTA have yielded amounts considerably less than these estimates. The residual contaminant saturation model could explain how traditional recovery efforts are ineffective while significant contaminant mass resides in the bedrock.

A total of 0.02 liters of product, all from JPZ1184, were removed from the FTA during all of 2003. There was no product measured or recovered from the remaining eighteen wells during the year. As a result of the limited amounts of product available for recovery at FTA, passive recovery of LNAPL product at FTA was discontinued. The Air Force has determined that in accordance with the *Sites Within OUs 5, 8, 9, 10, and 11 ROD* (HLA, 1999), it has been demonstrated that the established remedial action objective for FTA site has been achieved. The *Fire Training Area Remedial Action Completion Report* (MWH, 2005) was prepared and submitted in June 2005. Since the amount of product recovered is considerably less than the aforementioned product estimates, the Air Force will continue to recover LNAPL detected in wells during OU 12 groundwater monitoring activities.

The NFA determination for the FTA surface and subsurface soils is based on unlimited use and unrestricted exposure. The deed of transfer between the Air Force and the LDA and the transfer agreement between the Air Force and the USFWS establishes access rights to conduct any necessary remedial actions and monitoring. Groundwater use restrictions have also been established as required under the OU 12 ROD.

8.4.3 Implementation of Recommendations from Last Five-Year Review

The first *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for FTA remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- *Air Force to continue to conduct product recovery activities.*
- *Air Force to characterize product for presence of non-petroleum (i.e., chlorinated solvent) constituents.*

Routine LNAPL product recovery activities, including the volume of product recovered, were documented in the following:

- *Fire Training Area, Wherry Housing, and Jet Engine Buildup Shop 2002 Annual Product Recovery Report.* (MWH, 2003).
- *Fire Training Area, and Jet Engine Buildup Shop 2003 Annual Product Recovery Report.* (MWH, 2004a).
- *Fire Training Area Remedial Action Completion Report. (*MWH, 2005).

Routine groundwater sampling performed at FTA in accordance with the OU 12 program indicate that concentrations of chlorinated VOCs in groundwater are well below that which would be expected should non-petroleum (i.e., chlorinated solvent) constituents be present.

8.4.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

As documented in the *Fire Training Area Remedial Action Completion Report* (MWH, 2005) (prepared June, 2005) and described above, the remedial action objectives for FTA site established in the *Sites Within OUs 5, 8, 9, 10, and 11 ROD* (HLA, 1999) have been achieved. The Air Force has determined that it has been demonstrated that the

established remedial action objectives for FTA site have been achieved. The *Fire Training Area Remedial Action Completion Report* (MWH, 2005) was prepared and submitted in June 2005.

8.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: The remedy for the FTA site included No Further CERCLA Action for soils and passive recovery of LNAPL product. No chemical or location specific ARARs were identified for recovery of product at FTA.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: The selected remedy for FTA does not include attainment of remediation goals. Therefore, changes in toxicity or contaminant characteristics do not affect the implemented remedy.

Changes in Risk Assessment Methods: The human health risk assessment under the EE/CA was conducted following EPA Headquarters and EPA Region 1 guidance. The remedy selected under the ROD (LNAPL recovery) was not based on risk assessment methodology.

Expected Progress Toward Meeting RAOs: The remedial action objectives associated with passive recovery of LNAPL product at OU 8 have been met.

8.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.4.4.4 Technical Assessment Summary

As described above, the remedy at the FTA has functioned as intended by successfully monitoring for and recovering any detected free product within the shallow bedrock. As documented in the *Fire Training Area Remedial Action Completion Report* (MWH, 2005), the remedial action objectives have been met for the FTA within OU 8. In accordance with the *Sites Within OUs 5, 8, 9, 10, and 11 ROD* (HLA, 1999), it has been demonstrated that the FTA site has achieved the established remedial action objectives. The amount of recoverable product has significantly diminished since the recovery program began. When only 0.02 liters of product was recovered from the 19 wells at the site in 2003, it was determined that continuing the product recovery program was no longer feasible, which was the criteria set forth in the *ROD*.

Small amounts of free product may be detected in the wells in the future. Although it is not productive to conduct a periodic product recovery program, the Air Force will remove any free product encountered during regular groundwater monitoring events.

No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has come to light that would call into question the protectiveness of the remedy.

8.4.5 Issues

No issues were identified for OU 8.

8.4.6 Recommendations and Followup Actions

Routine long-term monitoring and reporting of groundwater conditions at the FTA under the OU 12 long-term monitoring program should continue, and free product recovery should be performed in association with groundwater monitoring, as necessary. It is recommended that the product recovery at FTA be removed from future Five-Year Reviews. This *Five-Year Review Report* would serve as the final review of product recovery remedial activities at OU 8.

8.4.7 Protectiveness Statement

The current remedy at FTA within OU 8 is protective of human health and the environment as the remedial action objectives have been met as detailed in the *Fire Training Area Remedial Action Completion Report* (MWH, 2005). Any small amounts of free product remaining will be removed during regular groundwater monitoring events conducted under the OU 12 Basewide Groundwater monitoring program.

8.4.8 References

ABB Environmental Services, Inc. (ABB-ES), 1995. *Loring Air Force Base Fire Training Area and Underground Transformer Site Operable Unit 8 Remedial Investigation Report*, Loring Air Force Base, ME. February.

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Bechtel, 1996b. *Bioventing at Operable Units 5, 8, 9, 10, and 11 Removal Action Report*; prepared for Department of the Air Force; Oak Ridge, Tennessee; April 1996.

Bechtel, 1999. *Biovent Sites Confirmation Sampling Field/Laboratory Results and Recommendations;* prepared for the Department of the Air Force; Oak Ridge, Tennessee; March 1999.

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HLA, 1999. *Sites within OUs 5, 8, 9, 10 and 11 Record of Decision*; Installation Restoration Program; Loring Air Force Base; September 1999.

J.T. Langille, Inc. (JTL), 1999. *Corrective Action Report Addendum #1, Removal of Aboveground and Underground Aircraft Refueling Facilities, UST/AST and Free Product Removal Project*; Loring Air Force Base; prepared for U.S. Army Corps of Engineers; Presque Isle, Maine; July 1999.

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MWH, 2005. *Fire Training Area Remedial Action Completion Report*; former Loring Air Force Base, June 2005.

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URS, 1999. *Fire Training Area Pilot Study Report.* January.

USEPA, 1996. *Guidance for Evaluation of Federal Agency Demonstrations that Remedial Actions are Operating Properly and Successfully Under CERCLA Section 120(h)(3).* Interim. August 1996.

8.5 OPERABLE UNIT 9, AUTO HOBBY SHOP

8.5.1 Background

8.5.1.1 Site Description

The South Flightline OU 9 is located in the south central portion of the former Loring AFB and includes the Auto Hobby Shop (AHS), Building 6570. The AHS site is located along the western side of Building 6570 northwest of the intersection of Weinman and Pennsylvania Roads (Figure 8.5-1), and the AHS and immediate vicinity occupy approximately 2.2 acres. The eastern third of the AHS is paved and relatively flat. The central and western portion of the AHS is covered with grass and slopes downward toward the Flightline Drainage Ditch (FLDD) about 200 feet away (AFBCA, 2000). Figure 8.5-2 shows the prominent features of the FTA site.

The AHS, Building 6570, was a garage used by base personnel to perform maintenance of personal vehicles. Activities included routine car maintenance, oil changes, parts cleaning, car painting, and car cleaning. Floor drains within the building were connected to the sanitary sewer system. Two USTs were located in the area of the AHS: a 5,000-gallon UST used to collect waste oil and a 5,000-gallon heating oil UST. The likely sources of contamination at the AHS site include the waste oil and heating oil USTs and potential spills and releases resulting from past site activities.

Unconsolidated soils at the AHS consist of fill overlying peat and ablation till. The fill consists of sandy silt, silty sand, and gravel and appears to thin towards the western side of the site near the FLDD and towards the eastern side near Pennsylvania Road. Fill varies in thickness from 5 feet along the western edge of the site to 13.5 feet in areas near the western edge of the AHS Building. Underlying the fill is a 3-foot to 4-foot layer of peat consisting of silt and organics. Ablation till underlies the peat and fill and is brown to gray silty sand with gravel. The thickness of the overburden and depth to bedrock ranges from 32.5 to 37 feet bgs.

Groundwater at the AHS occurs in both the unconsolidated overburden and the bedrock. The direction of flow in the overburden and the bedrock is primarily westerly toward the FLDD,

under hydraulic gradients of 0.003 feet per foot (ft/ft) in the overburden aquifer and 0.002 ft/ft in the bedrock. Flow in the southern portion of the site, toward Weinman Road, becomes southerly. Groundwater in the overburden aquifer occurs between 10-13 feet bgs (MWH, 2004).

8.5.1.2 Initial Response

Both USTs and contaminated soil associated with the heating oil UST were removed in 1992. Additionally, the heating oil UST was replaced with a new 2,000-gallon UST (AFBCA, 2000).

Because of the potential risks to human health, an EE/CA and a CAP were prepared for OU 9 (AFBCA, 2000). The CAP for the AHS proposed bioventing to treat the fuel-related soil contamination (ABB-ES, 1996). Site-specific, risk-based RGs, which also considered the potential impacts to groundwater due to leaching of contaminants, were developed for the AHS site and were included in the CAP (ABB-ES, 1996).

Based on the *Corrective Action Plan for OUs 5 & 9* (ABB-ES, 1996), a bioventing system was installed at the AHS site in 1996. The system includes 19 air injection wells and eight soil gas monitoring points. Following installation of the bioventing system, a 30-day testing period was initiated during which the system performance was monitored. As a result of this initial performance testing period, the final inspection of the bioventing system was performed and the system was certified operational and functional (PSP, 1997). Soil samples were collected at the AHS in 1997. The sampling results indicated TPH-contaminated soil outside the northeast portion of the treatment zone of the bioventing system. An additional air injection well was installed in January 1999 to address this area.

8.5.1.3 Basis for Taking Action

During RI activities conducted at the AHS between 1988 and 1994, 14 soil borings were completed to characterize the nature and distribution of soil contamination. Although the soil contamination at the AHS site is fuel-related, the EPA and MEDEP were concerned about the infrequent low level concentrations of chlorinated compounds detected in soils at the site

during the RI. Therefore, the AHS was placed under the CERCLA process until soil confirmation samples verify that these contaminants do not pose a site risk.

Soils west of the AHS building were primarily contaminated with petroleum hydrocarbons from the ground surface to the saturated zone within the overburden. Figure 8.5-3 illustrates the historical extent of TPH contamination at the AHS from the RI report (ABB-ES, 1995). TPH contamination extended west, northwest, and southwest of the building from the ground surface to a maximum depth of 16 feet below ground surface (PSP, 1997). TPH contamination was deepest near the AHS building and associated with former waste oil and fuel oil USTs, and was shallower as the thickness of the overburden decreases toward the west. The detected concentrations of TPH during the RI soil investigations ranged from 37 to 39,000 mg/kg and were widely distributed; however, the higher concentrations were measured at depths near the groundwater table (ABB-ES, 1995a), as indicated by the data tables in Figure 8.5-3.

8.5.2 Remedial/Removal Actions

The following subsections describe remedial actions at AHS.

8.5.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Sites Within OUs 5, 8, 9, 10 and 11 Record Of Decision

The *Sites Within OUs 5, 8, 9, 10 and 11 Record of Decision* (HLA, 1999) documented the selection of a remedy that included continued operation of the bioventing system at the AHS site to continue to address the petroleum- and solvent-contaminated subsurface soils.

8.5.2.2 Remedial Action Objectives

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial objectives were presented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). These remedial objectives were developed to mitigate existing and future potential threats to public health and the environment. The general RAOs

relevant to the AHS identified in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) are stated as follows:

1. Prevent human exposure (i.e., ingestion, inhalation, and dermal contact) to contaminated soil with concentrations in excess of remediation goals.
2. Prevent ecological exposure (i.e., ingestion, inhalation, and biological uptake) to contaminated soil with concentrations in excess of remediation goals.
3. Prevent contaminated soil with concentrations in excess of remediation goals from migrating to groundwater.

8.5.2.3 Remedy Description

The chosen remedy for AHS as described in the *ROD* included the continued operation, performance monitoring and data reporting for the bioventing system until the risk-based remediation goals are achieved, allowing for unlimited use of the site and unrestricted exposure.

Contaminants of concern and site-specific remediation goals were developed for AHS in the EE/CA and were included in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). In the development of remediation goals for AHS, human health and ecological risk-based values were calculated and soil leaching model values were calculated. The site-specific remediation goals for AHS represent the most stringent of these values. The AHS remediation goals are listed in Table 8.5-1.

The chosen remedy for AHS as described in the *ROD* also included the conductance of Five-Year site reviews until the levels of contaminants remaining at the site allow for unlimited use and unrestricted exposure.

8.5.2.4 Remedy Implementation

Based upon the recommendations of the CAP the bioventing system was installed at the AHS site in 1996 as an initial response action. Soil samples were collected at the AHS in 1997. The sampling results indicated TPH-contaminated soil outside the northeast portion of the treatment zone of the bioventing system. An additional air injection well was installed in

January 1999 to address this area. The chosen remedy for AHS documented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) was the continued operation of the biovent system. The system was certified operational and functional in the *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report* (Bechtel, 1996).

An increase in biovent air flow of up to 3 times the original design was recommended in the *2002 Annual Performance Report* (MWH, 2003) in an attempt to accelerate remediation by better distributing the oxygen and enhancing biodegradation. The existing blower capacity was not sufficient to accommodate this flow; hence, in late July 2003, a larger blower was moved to the site and connected to the piping network. Although system operation remained biovent, the proposed air flow rates were sufficiently high that some volatilization of the contaminants was possible. If this occurred, most vapors would harmlessly exit through the soil surface; however, the AHS building was located in close enough proximity that the possibility existed for vapors to migrate under the building foundation and up through cracks in the concrete floor.

To eliminate this potential risk to AHS employees, vacuum vapor recovery is in operation on the building's concrete floor gravel subbase and at AEW-16 to capture any vapors that may migrate under the building frost wall. The enhanced system was started on July 22, 2003. The new operational mode has significantly increased AIW air injection rates.

The AHS bioventing system was determined to be operating as designed in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004a). Annual confirmation soil sampling is performed to monitor remedial progress at the site and has shown that the bioventing system at the AHS site has nearly achieved established RGs. Soil sampling will continue until results indicate that the site has achieved RGs and is suitable for unlimited use and unrestricted exposure.

LUC/ICs are in place for AHS in the form of restrictions in the transfer agreement that was executed between the Air Force and the U.S. Department of Labor and in the deed that was executed with the LDA. As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the transfer documents contain provisions restricting any

activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact on the protectiveness of the remedial action.

The deed and transfer agreement implemented several LUC/IC measures. These include general provisions allowing for the Air Force continued operation of the biovent system in the future including right of access to conduct, operate, maintain or undertake any remedial action required under the Loring IRP. Additional LUC/IC measures include a URZ prohibiting any subsurface excavating, digging, drilling, subsurface construction or other disturbance of the surface without notice to and written approval of the Air Force.

The LUC/ICs implemented for AHS are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

8.5.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for AHS remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- System performance should be reviewed annually, including collection and analysis of soil samples to monitor progress toward RGs. A full round of soil confirmation samples should be taken when it appears that RGs have been achieved.
- Five-year site reviews will be conducted for the AHS site under OU 9 (source control) until the levels of contaminants remaining at the site allow for unlimited use and unrestricted exposure.

Annual evaluation of system performance including the collection of confirmation soil samples, progress toward RGs, and optimization efforts were documented in the following:

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001* (MWH, 2002a)

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2001 – February 2002* (MWH, 2002b)

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2002 – February 2003* (MWH, 2003)

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2003 – December 2003* (MWH, 2004b)

This *Five-Year Review Report* documents the second review for the AHS site under OU 9 source control.

8.5.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

As documented in the Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully (MWH, 2004a) the chosen remedy is protective of human health and the environment and facilitating the attainment of RAOs. While the soil RGs at the AHS site have not been met, mass destruction is still occurring.

8.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: ARARs do not exist for soil at AHS. Site-specific, risk-based remediation goals were developed during the CAP considering both current and projected future land use at AHS.

Changes in Exposure Pathways: Since completion of the last Five Year Review, additional guidance, including EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November, 2002), have been developed to aid in evaluating the potential for human exposure from this pathway. Soil vapors that may pose a threat to indoor air quality are addressed by the remedial action.

Changes in Toxicity and Other Contaminant Characteristics: Based on the current and anticipated future land use of the AHS site as a Job Corps Training Center for the Department of Labor (AFBCA, 1996), the commercial/industrial worker and construction worker may be exposed to contaminated soil by incidental ingestion, dermal absorption, and inhalation of VOCs and dust. The ecological RA conducted for the site concluded that there are no significant risks to ecological receptors from exposure to contaminated soil. The RGs developed in the CAP are designed to be protective of groundwater at AHS and are based upon the soil leaching model results that would result in groundwater at concentrations less than the Federal Safe Drinking Water Act MCLs or the MEGs.

Remediation goals were established for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and TPH at the Auto Hobby Shop. Current human health inhalation carcinogenic toxicity factors for benzo(a)anthracene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene are lower than those used in the risk assessment (See Table 8.3-2). However, carcinogenic risks from exposure to these chemicals were within the risk range of $1x10^{-6}$ to $1x10^{-4}$. Based on review of the final remediation goals selected under the ROD, the final standards were based on soil leaching model values and potential threats from TPH in soil to groundwater. Therefore, the final remediation goals were not selected on the basis of the human health and ecological risk assessments. Therefore, changes in toxicity factors do not affect the remediation goals.

In addition to the constituents for which remediation goals were calculated, several others were identified as COPCs in the human health risk assessment. It is possible that changes in toxicity values for some COPCs may result in total estimated risk that exceeds target risk level. Therefore, toxicity factors for all COPCs were evaluated to identify changes in values used in the risk assessment versus values currently available. Tables 7.3-2 and 8.3-2 list all

COPCs identified in soil at OU 9 for which toxicity factors have changed. Toxicity factors remain unchanged for all other COPCs not listed in Tables 7.3-2 and 8.3-2.

Among the COPCs identified at OU 9, toxicity factors have changed for a number of COPCs. However, estimated risks using currently available toxicity factors will not significantly add to the total risks. In addition, several compounds currently have toxicity factors available, that were not available at the time of the risk assessment. Estimated risks due to exposure to these compounds would not be significant if currently available toxicity factors were used.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any significant change in EPA guidance, which could result in significant revisions to the remediation goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to remediation goals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy for AHS is expected to meet each of the RAOs, based on observed decreasing contaminant concentration trends of COCs in soil.

8.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.5.4.4 Technical Assessment Summary

As described above, the remedy at AHS is functioning as intended by successful operation, monitoring and reporting of the bioventing system, as well as conducting five-year site reviews. While the soil RGs at the AHS site have not been met, mass destruction is still occurring. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, and no other information has come to light that would call into question the protectiveness of the remedy.

8.5.5 ISSUES

No issues were identified for the AHS site.

8.5.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine annual system performance reviews and confirmation soil sampling should continue. Routine monitoring for AHS should also include monitoring of LUC/ICs to document their continued effectiveness.

8.5.7 PROTECTIVENESS STATEMENT

The remedial action at AHS in OU 9 (operation of the biovent system; implementation of LUC/ICs and five-year site reviews) is protective of human health and the environment, and will remain so in the future as soil remediation goals are achieved.

8.5.8 REFERENCES

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8.6 OPERABLE UNIT 10, ENTOMOLOGY SHOP/JET ENGINE BUILDUP SHOP

8.6.1 BACKGROUND

8.6.1.1 Site Description

The Entomology Shop (ES), Building 8265, consisted of a small two-story building located in the central portion of the Flightline Area (FLA), east of Arizona Road (Figure 8.6-1). The ES and immediate vicinity occupy approximately 1.8 acres. The Jet Engine Buildup Shop (JEBS), Building 8260, is located within the boundaries of IRP OU 10, which lies west of the FLA in the industrial area of the base. The JEBS and immediate vicinity occupy approximately four acres.

The JEBS building is surrounded by many buildings, and varying amounts of bituminous pavement and concrete cover the ground surface on all four sides of the JEBS, controlling the surface water runoff and drainage. The surface water drainage is primarily to the west and south on the southern end of the JEBS. The surface water is collected in a channel southwest of the building which continues toward the ES. This swale also receives discharge from the drainage features on the east side of the JEBS (Figure 8.6-2).

The ES site was originally used as a treatment facility for wastewater from the JEBS and the Double Cantilever (DC) and Arch Hangars. In the early 1970s, the building was converted for use in mixing and storing pesticides and herbicides for routine application at the base. No spills were recorded at the site. In 1992, operations were moved and the building was left vacant. The likely sources of contamination at the site include the drainlines connected to the ES building and the ES building basement where the former wastewater treatment process occurred (AFBCA, 2000).

Activities associated with the JEBS site included draining, maintenance, repair, teardown, and modification of jet engines. Facilities at the JEBS included a small washrack room in the northwest corner of the building. Wash water was collected in a floor drain, piped to a sand and grease trap and OWS just outside the building, then to the ES for treatment. From 1952 to 1991, the types of waste stored at the JEBS included paint waste, chemical waste and

mixed petroleum waste. Contamination detected in soil at JEBS consists primarily of constituents originating from cleaning agents/solvents, greases, oils, and paints, which were used on a regular basis at the JEBS (AFBCA, 2000).

The overburden in the vicinity of JEBS is unsaturated with respect to groundwater and consists of varying amounts of fill and glacial till, which overlay limestone bedrock. The average depth to groundwater across the site ranges from approximately 9 to 14 feet bgs. When the Base was constructed, an unknown quantity of fill was excavated and placed in the JEBS area for the construction of the flightline. Generally, the fill present in the vicinity of the JEBS building consists of re-worked till which is described as an olive brown sandy silt to silty sand with little to some sub-rounded to sub-angular gravel and is massive in appearance. The contact between fill and till deposits in JEBS area is generally encountered 6 to 8 feet bgs. Undisturbed till encountered at the JEBS appears to be predominantly a basal till comprised of basal drift and lodgement till. The basal till is generally described as an olive brown to olive gray sandy silt and silty sand with trace to little clay. Elevation of the bedrock surface appears to be highest in the vicinity of Building 8261. The bedrock surface ranges from approximately 709 feet MSL to 695 feet MSL across the site. The bedrock surface is relatively flat immediately north of the JEBS building and gently sloping to the west-southwest across the remainder of the site (i.e. south, east, and west of the building). The bedrock underlying the unconsolidated deposits at JEBS consists of low-grade metamorphic limestone classified as the upper Cary Mills Formation (MWH, 2004a).

8.6.1.2 Initial Response

Due to the potential risks to human health and ecological receptors, an EE/CA was prepared for ES and JEBS recommending a combination of bioventing and excavation of contaminated soil with disposal at LF-3 (URS, 1995a). Preliminary RGs were developed for the ES site and were included in the EE/CA (URS, 1995a). Excavation activities conducted at the ES during the 1995 and 1996 construction seasons, resulted in the excavation of approximately 10,207 cy of contaminated soil, which were disposed of at LF 3. The ES building walls and foundation were demolished in 1995 and the waste drainline from the JEBS was removed. Contaminated soil was also removed from the area beneath and

surrounding the building. Further soil and drainline excavation was completed in 1996. Soil confirmation samples collected following drainline excavations indicated that the 1995 preliminary remediation goals were met for these portions of the ES/JEBS sites (Bechtel, 1996 and 1997a).

Based on the *Action Memorandum for OUs 5, 8, 9, 10, and 11* (URS, 1995b), a bioventing system was installed at the ES site in 1996. The system continued to operate to address the fuel-contaminated soil in the vicinity of the building foundation until 1998 when soil confirmation samples were collected. The data indicated that the site-specific, preliminary remediation goals for the fuel-related contaminants had been achieved; however, TCE and PCE were detected at concentrations in excess of the preliminary remediation goals (Bechtel, 1999a).

Based on the *Action Memorandum for the JEBS and Building 8710* (Bechtel, 1998), an in-situ SVE system was installed at the JEBS site in 1998. The system includes 52 air extraction wells, 10 air vents, and 12 soil gas monitoring points. Following installation of the SVE system, a 30-day testing period was initiated during which the system performance was monitored. As a result of this initial performance testing period, normal operation of the system began in December 1998 (Bechtel, 1999b) and has remained in operation since.

Based on the *Biovent Sites Confirmation Sampling Field/Laboratory Results and Recommendations* (Bechtel, 1999a), three bioventing wells located immediately adjacent to the former ES building foundation were connected to the in-situ SVE system at the JEBS site in 1998 (Bechtel, 1999a). Following conversion of the wells and connection to the SVE system at the JEBS site, a 30-day testing period was initiated during which the system performance was monitored. As a result of this initial performance testing period, normal operation of the system began in December 1998 (Bechtel, 1999c).

8.6.1.3 Basis for Taking Action

During RI activities conducted at the ES between 1988 and 1993, soil borings were completed to characterize the nature and distribution of soil contamination, and sampling and analysis of the drains connected to the ES building and of the sludge and water in the ES

building basement were conducted. The RI identified fuel, solvent, and pesticide-related contaminants in soil at the site (ABB-ES, 1994).

During RI activities conducted at JEBS, constituents originating from cleaning agents/solvents, greases, oils, and paints, which were used on a regular basis at the JEBS, were detected in soils. During additional SI activities conducted at the JEBS in 1997, 91 TerraProbe™ explorations and 31 soil borings were completed to characterize the nature and distribution of soil contamination. The SI identified three areas of subsurface soil contamination north, south, and southwest of the JEBS building (HLA, 1998). The likely sources of this contamination include the washrack, floor drains, oil and grease trap, OWS, and spills resulting from past activities at the JEBS site.

8.6.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe remedial actions at ES/JEBS.

8.6.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Sites Within OUs 5, 8, 9, 10 and 11 Record Of Decision

The *Sites Within OUs 5, 8, 9, 10 and 11 Record of Decision* (HLA, 1999) documented the selection of a remedy that included continued operation of the SVE system at the ES and JEBS sites to continue to address the petroleum and solvent-contaminated subsurface soils.

8.6.2.2 Remedial Action Objectives

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial objectives were presented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). These remedial objectives were developed to mitigate existing and future potential threats to public health and the environment. The general RAOs relevant to the ES/JEBS identified in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) are stated as follows:

1. Prevent human exposure (i.e., ingestion, inhalation, and dermal contact) to contaminated soil with concentrations in excess of remediation goals.

2. Prevent ecological exposure (i.e., ingestion, inhalation, and biological uptake) to contaminated soil with concentrations in excess of remediation goals.

3. Prevent contaminated soil with concentrations in excess of remediation goals from migrating to groundwater.

8.6.2.3 Remedy Description

The chosen remedy for ES/JEBS as described in the *ROD* included the continued operation, performance monitoring and data reporting for the SVE system until the risk-based remediation goals are achieved, allowing for unlimited use of the site and unrestricted exposure.

Contaminants of concern and site-specific remediation goals were developed for ES/JEBS in the EE/CA and were included in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). In the development of remediation goals for ES/JEBS, human health and ecological risk-based values were calculated and soil leaching model values were calculated. The site-specific remediation goals for ES/JEBS represent the most stringent of these values. The ES/JEBS remediation goals are listed in Table 8.6-1.

The chosen remedy for ES/JEBS as described in the *ROD* also included performing five-year site reviews until the levels of contaminants remaining at the site allow for unlimited use and unrestricted exposure.

8.6.2.4 Remedy Implementation

Based on the *Action Memorandum for the JEBS and Building 8710* (Bechtel, 1998), an in-situ SVE system was installed at the JEBS site in 1998. Based on the *Biovent Sites Confirmation Sampling Field/Laboratory Results and Recommendations* (Bechtel, 1999a), three bioventing wells located immediately adjacent to the former ES building foundation were connected to the in-situ SVE system at the JEBS site in 1998 (Bechtel, 1999a). The chosen remedy for ES and JEBS documented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) was the continued operation of the SVE system.

The SVE system at ES and JEBS continues to be operated. The ES/JEBS SVE system was determined to operating as designed in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004a). Annual confirmation soil sampling is performed to monitor remedial progress at the site and has shown that the SVE system at the JEBS site has reduced the areal extent of soil above the established RGs. Airflow is and will be focused in these locations to address remaining chlorinated contamination. Soil sampling will continue until results indicate that the site has achieved RGs and is suitable for unlimited use and unrestricted exposure.

LUC/ICs are in place for ES/JEBS in the form of restrictions in the deed that was executed between the Air Force and the current owners of the property (LDA). As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the deed of transfer contains provisions restricting any activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact on the protectiveness of the remedial action.

The deed implemented several LUC/IC measures. These include general provisions allowing for the Air Force continued operation of the SVE system in the future including right of access to conduct, operate, maintain or undertake any remedial action required under the Loring IRP. Additional LUC/IC measures include a URZ prohibiting any subsurface excavating, digging, drilling, subsurface construction or other disturbance of the surface without notice to and written approval of the Air Force.

The LUC/ICs implemented for ES/JEBS are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

8.6.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for ES/JEBS remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- The entire system needs to be evaluated for effectiveness in 2000.
- Annual system performance reviews should include collection and analysis of subsurface soil samples in order to document progress toward the RGs.
- The next five-year review will be in 2005.

The *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001* (MWH, 2002a) documented that the SVE system at ES/JEBS removed approximately 410 pounds of VOCs from soils during 2000, and recommended continued operation of the SVE system with minor changes to further optimize the progress towards RGs

Annual evaluation of system performance including the collection of confirmation soil samples, progress toward RGs, and optimization efforts were documented in the following:

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001* (MWH, 2002a)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2001 – February 2002* (MWH, 2002b)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2002 – February 2003* (MWH, 2003)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2003 – December 2003* (MWH, 2004b)

This *Five-Year Review Report* documents the second review for the ES/JEBS site under OU 10 source control.

8.6.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.6.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

As documented in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004a). The remedy at ES/JEBS is functioning as intended by the decision documents. While the soil RGs at the JEBS/ES site have not been met, mass destruction is still occurring, and the chosen remedy is protective of human health and the environment and facilitating the attainment of RAOs.

8.6.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: ARARs do not exist for soil at ES/JEBS. Site-specific, risk-based remediation goals were developed during the EE/CA considering both current and projected future land use at ES/JEBS. The RGs were developed by evaluating human health and ecological risk-based values as well as soil leaching model results.

Changes in Exposure Pathways: Since completion of the last Five Year Review, additional guidance, including EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November, 2002), have been developed to aid in evaluating the potential for human exposure from this pathway. The Air Force will consider this and any other appropriate guidance to determine if the vapor intrusion pathway at ES/JEBS requires additional analysis.

Changes in Toxicity and Other Contaminant Characteristics: Remediation goals that are protective of human health and the environment were established based on the EPA and

MEDEP Risk Assessment Guidance and the *LAFB Risk Assessment Methodology* (HAZWRAP, 1994). Human health remediation goals were calculated using a $1x10^{-6}$ risk level for carcinogens and a HI of one for noncarcinogens. Ecological remediation goals were developed by back-calculating the ecological models to obtain soil concentrations that would result in a HQ of one. Soil leaching model results were used to develop soil remediation goals that would result in groundwater at concentrations less than the Federal Safe Drinking Water Act MCLs or the MEGs.

Remediation goals were established for TCE and PCE at ES. However, carcinogenic risks from exposure to these chemicals did not exceed $1x10^{-6}$. While current human health toxicity factors for TCE are higher than those used in the risk assessment (See Tables 7.3-2 and 8.3-2), changes in toxicity factors do not affect the remediation goals.

Although carcinogenic risks exceeded $1x10^{-4}$ for several receptors, COPCs contributing to the risks were not selected for development of remediation goals in the risk assessment. In addition, noncarcinogenic hazards did exceed HI=1 for construction workers, but remediation goals were not developed for the COPC contributing to the risk. Based on review of the final remediation goals selected under the ROD, the final standards were based on soil leaching model values and potential threats from TPH in soil to groundwater. Therefore, the final remediation goals were not selected on the basis of the human health and ecological risk assessments

Remediation goals were established for benzo(a)anthracene, benzo(a)pyrene, chrysene, PCE and TCE at the JEBS. Available human health inhalation carcinogenic toxicity factors for benzo(a)anthracene, and chrysene are lower than those used in the risk assessment, (See Table 8.3-2) and TCE toxicity factors are higher than those used in the risk assessment. Carcinogenic risks from exposure to these chemicals were within the risk range of $1x10^{-6}$ to $1x10^{-4}$. Noncarcinogenic risks to all receptors were less than HI=1. As was the case with remediation goals for the ES, remediation goals for the JEBS were not developed based on results of human health and ecological risk assessments. Remediation goals were developed because of presence of potential adverse effect on groundwater quality. Therefore, changes in toxicity factors do not affect the remediation goals applied under the ROD.

In addition to the constituents for which remediation goals were calculated, several others were identified as COPCs in the human health risk assessment. It is possible that changes in toxicity values for some COPCs may result in total estimated risk that exceeds target risk level. Therefore, toxicity factors for all COPCs were evaluated to identify changes in values used in the risk assessment versus values currently available. Tables 7.3-2 and 8.3-2list all COPCs identified in soil at OU 10 at the Loring AFB for which toxicity factors have changed. Toxicity factors remain unchanged for all other COPCs not listed in Tables 7.3-2 and 8.3-2.

Among the COPCs identified at OU 10, toxicity factors have changed for a number of COPCs. For carcinogenic risks, estimated risks using currently available toxicity factors would not significantly add to the total risks. Noncarcinogenic risks would exceed HI=1 for both alpha chlordane and gamma chlordane for all receptors at the ES if currently available toxicity factors are used. However, the increase may not be significant considering the uncertainties associated with estimation of noncarcinogenic risks.

In addition, several compounds currently have toxicity factors available, that were not available at the time of the risk assessment. Estimated noncarcinogenic risks due to exposure to these compounds will not be significant if currently available toxicity factors are used.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any significant change in EPA guidance, which could result in significant revisions to the remediation goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to remediationgoals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy for ES/JEBS is expected to meet each of the RAOs, based on observed decreasing contaminant concentration trends of COCs in soil.

8.6.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.6.4.4 Technical Assessment Summary

As described above, the remedy at ES/JEBS is functioning as intended by successful operation, monitoring and reporting of the SVE system, as well as conducting five-year site reviews. While the soil RGs at the ES/JEBS site have not been met, mass destruction is still occurring. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, and no other information has come to light that would call into question the protectiveness of the remedy.

8.6.5 ISSUES

No issues were identified for the ES/JEBS site.

8.6.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine annual system performance reviews and confirmation soil sampling should continue. Routine monitoring for JEBS/ES should also include monitoring of LUC/ICs to document their continued effectiveness.

8.6.7 PROTECTIVENESS STATEMENT

The remedial action at ES and JEBS in OU 10 (operation of the biovent system; implementation of LUC/ICs and five-year site reviews) is protective of human health and the environment, and will remain so in the future as soil remediation goals are achieved.

8.6.8 REFERENCES

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Bechtel, 1997 b. *Bioventing at OUs 5, 8, 9,10 and 11, Remedial Action Report, Addendum 1;* Final; Prepared for the Department of the Air Force, Oak Ridge, Tennessee; May.

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8.7 OPERABLE UNIT 11, BASE LAUNDRY

8.7.1 BACKGROUND

8.7.1.1 Site Description

OU 11 is located in the south central portion of the Site and includes the Base Laundry (BL), Building 7330 (figure 8.7-1). The site is located northeast of the intersection of South Carolina Road and Pennsylvania Road. The site is approximately five acres in size and consists of one building (Figure 8.7-2).

Prior to 1970, the base laundry building, Building 7330, was used as a bakery; the laundry became operational in 1971. As part of the laundry operations, dry cleaning was performed in the building. PCE was originally delivered to the laundry in drums, then later by a tank truck that pumped into an AST north of the building. Used PCE was originally containerized in drums and was later sent to a second AST. Spills or releases may have occurred on or surrounding the pavement near the building. Floor drains in the area of dry cleaning operations appeared to empty into the storm sewer which discharges into an open drainage ditch southwest of the site (MWH, 2004a).

The geology at the Base Laundry site has been characterized as reworked till (fill) and glacially-derived till overlying limestone bedrock. The fill is composed of silty clay to sandy silt with coarse gravel, and ranges in thickness from 0 to 6 feet. The fill overlies till composed of olive brown to gray, firm to compact, silt and sand with lesser amounts of gravel and cobbles. The thickness of the till at the Base Laundry is between 6 and 29 feet. Bedrock is gray to bluish gray, layered, pelitic limestone ranging in depth from approximately 6 to 36 feet bgs across the site. A frost wall is present along the Base Laundry building foundation which extends to a depth of approximately 7 feet bgs (ABB-ES, 1995).

8.7.1.2 Initial Response

Because of the potential risks to human health and ecological receptors, an EE/CA and an Action Memorandum were prepared for the site recommending in-situ SVE for the PCE-contaminated soil (URS, 1996a). Based on the *Action Memorandum for the BL*

(URS, 1996b), an in-situ SVE system was installed at the BL site in 1996. Following installation of the SVE system, a 30-day testing period was initiated during which the system performance was monitored. As a result of this initial performance testing period, normal operation of the system began in September 1996 (Bechtel, 1997). The SVE system initially consisted of two vertical air extraction wells (AEWs). In 1997 a horizontal AEW was installed. Based on 1998 soil sampling results, three additional vertical AEWs were installed (Bechtel, 1999).

8.7.1.3 Basis for Taking Action

During RI activities conducted at the BL between 1988 and 1994, TerraProbe™ explorations and soil borings were completed to characterize the nature and distribution of soil contamination. The RI identified PCE in subsurface soils in the vicinity of the BL (ABB-ES, 1996). PCE is the main contaminant of concern and was present in a number of areas around the Base Laundry.

8.7.2 Remedial/Removal Actions

The following subsections describe remedial actions at BL.

8.7.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Sites Within OUs 5, 8, 9, 10 and 11 Record Of Decision

The *Sites Within OUs 5, 8, 9, 10 and 11 Record of Decision* (HLA, 1999) documented the selection of a remedy that included continued operation of the SVE system at the BL site to remediate the PCE contaminated subsurface soils.

8.7.2.2 Remedial Action Objectives

Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial objectives were presented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). These remedial objectives were developed to mitigate

existing and future potential threats to public health and the environment. The general RAOs relevant to the AHS identified in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) are stated as follows:

1. Prevent human exposure (i.e., ingestion, inhalation, and dermal contact) to contaminated soil with concentrations in excess of remediation goals.
2. Prevent ecological exposure (i.e., ingestion, inhalation, and biological uptake) to contaminated soil with concentrations in excess of remediation goals.
3. Prevent contaminated soil with concentrations in excess of remediation goals from migrating to groundwater.

8.7.2.3 Remedy Description

The chosen remedy for BL as described in the *ROD* included the continued operation, performance monitoring and data reporting for the SVE system until the risk-based remediation goals are achieved, allowing for unlimited use of the site and unrestricted exposure.

Contaminants of concern and site-specific remediation goals were developed for BL in the EE/CA and were included in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999). In the development of remediation goals for BL, human health and ecological risk-based values were calculated and soil leaching model values were calculated. The site-specific remediation goal for BL represents the most stringent of these values. The BL remediation goal is listed in Table 8.5-1.

The chosen remedy for BL as described in the *ROD* also included performing five-year site reviews until the levels of contaminants remaining at the site allow for unlimited use and unrestricted exposure.

8.7.2.4 Remedy Implementation

Based on the *Action Memorandum for the BL* (URS, 1996), an in-situ SVE system was installed at the BL site in 1996. The chosen remedy for BL documented in the *Sites Within OUs 5, 8, 9, 10 and 11 ROD* (HLA, 1999) was the continued operation of the SVE system.

The system was certified operational and functional in the *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report* (Bechtel, 1996).

New AEWs were added to the SVE system in 1997 and again in 1998. The newest AEWs were placed in areas of high PCE concentrations adjacent to the BL in order to improve system performance (SAIC, 2001). The SVE system currently consists of five vertical and one horizontal AEW, as shown in Figure 8.7-2. Contaminant mass removal rates were declining, but were still progressing the site toward closure when the SVE system was last operated in August 2002. A chemical oxidation pilot study was completed at this site in late 2002 and 2003 which necessitated the temporary shut down of the SVE system; however, following the analysis of the test results, the SVE system was restarted. The BL was determined to be operating as designed in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004b).

In January 2005, an assessment of remedial alternatives was completed to address PCE in soil at the BL site. The goal of this alternatives analysis was to optimize the remedy in place at BL and reduce the remedial timeframe. Additional soil delineation performed during the optimization evaluation indicated that the areal extent of PCE in soil underneath the BL building is greater than that determined during the RI.

Currently, the selected remedial alternative is partial demolition of the BL building and excavation and landfarming of soils containing PCE above the RG, and this optimized remedy has been agreed upon by the Air Force, EPA and MEDEP. The soil will be landfarmed until PCE concentrations are below 5.64 mg/kg and returned to the site. Demolition of the building and soil landfarming are expected to be completed by the end of 2005. It is anticipated that at the completion of the remedy optimization the RAOs for the BL will be achieved.

LUC/ICs are in place for BL in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (LDA). As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the deed of transfer contains provisions restricting any activities that could jeopardize the protectiveness of the

remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force screens and approves proposed activities that are determined to have no impact on the protectiveness of the remedial action.

The deed implemented several LUC/IC measures. These include general provisions allowing for the Air Force continued operation of the SVE system in the future including right of access to conduct, operate, maintain or undertake any remedial action required under the Loring IRP, including the optimization alternative. Additional LUC/IC measures include a URZ prohibiting any subsurface excavating, digging, drilling, subsurface construction or other disturbance of the surface without notice to and written approval of the Air Force.

The LUC/ICs implemented for BL are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

8.7.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for BL remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- The in-situ SVE system at the BL site should continue to operate.
- Annual system performance reviews should include collection and analysis of subsurface soil samples in order to document progress toward the RGs.

Annual evaluation of system performance including the collection of confirmation soil samples, progress toward RGs, and optimization efforts were documented in the following:

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, February 2000 – February 2001* (MWH, 2002a)
- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2001 – February 2002* (MWH, 2002b)

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2002 – February 2003* (MWH, 2003)

- *Bioventing and Soil Vapor Extraction at OUs 5, 8, 9, 10, and 11, Annual Performance Report, March 2003 – December 2003* (MWH, 2004b)

This *Five-Year Review Report* documents the second review for the BL site under OU 11 source control.

8.7.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.7.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

As documented in the *Auto Hobby Shop, Jet Engine Build-Up Shop/Entomology Shop, Former Jet Engine Test Cell and Base Laundry Sites Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004a), the chosen remedy is protective of human health and the environment and is facilitating the attainment of RAOs. While the soil RGs at the BL site have not been met, mass destruction is still occurring. As indicated in Section 8.7.2.4 the Air Force has evaluated various remedial alternatives designed to facilitate the achievement of the RAOs in a shorter timeframe than the current remedy. EPA and MEDEP have provided concurrence on the implementation of the remedial alternative described above, which will accelerate the attainment of RAOs at the BL. It is anticipated that at the completion of the remedy optimization the RAOs for the BL will be achieved.

8.7.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: ARARs do not exist for soil at BL. Site-specific, risk-based remediation goals were developed during the EE/CA considering both current and projected future land use at BL.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Based on the anticipated future land use of the BL site for aviation and industrial purposes (AFBCA, 1996), the human health RA determined that a construction worker may be exposed to contaminated subsurface soil by incidental ingestion, dermal absorption, and inhalation of VOCs and dust. The ecological RA conducted for the site concluded that there are calculable risks to ecological receptors from exposure to contaminated soil. The RG developed in the EE/CA for PCE at the BL is designed to be protective of groundwater and is based upon the soil leaching model result that would result in groundwater at concentrations less than the Federal Safe Drinking Water Act Maximum Contaminant Levels or the Maine Maximum Exposure Guideline.

A remediation goal was established for PCE at OU 11. Carcinogenic risks from exposure to PCE did not exceed $1x10^{-6}$. The cleanup standards ultimately presented in the ROD were based on the leaching model and potential adverse effects on groundwater. Cleanup standards were not developed based on results of human health and ecological risk assessments. Toxicity factors for PCE have not changed since the risk assessment was conducted.

In addition to PCE, several others were identified as COPC in the human health risk assessment. It is possible that changes in toxicity values for some COPCs may result in total estimated risk that exceeds target risk level. Therefore, toxicity factors for all COPCs were evaluated to identify changes in values used in the risk assessment versus values currently available. Tables 7.3-2 and 8.3-2 list all COPCs identified in soil at OU 11 for which toxicity

factors have changed. Toxicity factors remain unchanged for all other COPCs not listed in Tables 7.3-2 and 8.3-2.

Among the COPCs identified at OU 11, toxicity factors have changed for a number of COPCs. However, estimated risks using currently available toxicity factors would not significantly add to the total risks. In addition, several compounds currently have toxicity factors available, that were not available at the time of the risk assessment. Estimated risks due to exposure to these compounds would not be significant if currently available toxicity factors were used.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any significant change in EPA guidance, which could result in significant revisions to the cleanup goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy for BL is expected to meet each of the RAOs, based on observed decreasing contaminant concentration trends of COCs in soil.

8.7.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Additional soil delineation performed at the BL site in January 2005 during remedial optimization efforts indicates that PCE contamination in soil exists outside of the area of influence of the SVE system. Currently, the selected remedial alternative is partial demolition

of the BL building and excavation and landfarming of soils containing PCE above the RG and has been agreed upon by the Air Force, EPA and MEDEP. Demolition of the building and soil landfarming are expected to be completed by the end of 2005. It is anticipated that at the completion of the remedy optimization the RAOs for the BL will be achieved. Until the completion of the remedy optimization, LUC/ICs in place at the BL remain protective of human health and the environment.

8.7.4.3 Technical Assessment Summary

As described above, the remedy at BL is functioning as intended by the *ROD* by successful operation, monitoring and reporting of the SVE system, as well as conducting five-year site reviews. Additionally, LUC/ICs are in place and performing as expected. The additional areal extent of soil contamination at the BL discovered outside of the area of influence of the SVE system in January 2005 is being addressed by remedial optimization efforts of the Air Force. The alternative remedy consisting of partial demolition of the BL building and excavation and landfarming of soils containing PCE above the RG has been agreed upon by the Air Force, EPA and MEDEP, and is scheduled to be completed in 2005. It is anticipated that at the completion of the remedy optimization the RAOs for the BL will be achieved.

No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has come to light that would call into question the protectiveness of the remedy.

8.7.5 Issues

As indicated above, the extent of PCE contamination in soil exists outside of the area of influence of the SVE system. Currently, the selected remedial alternative is partial demolition of the BL building and excavation and landfarming of soils containing PCE above the RG and has been agreed upon by the Air Force, EPA and MEDEP, and is scheduled to be completed in 2005. It is anticipated that at the completion of the remedy optimization the RAOs for the BL will be achieved.

8.7.6 Recommendations and Followup Actions

Excavation and landfarming of the BL soils should be conducted in 2005 as described above. The soil will be landfarmed until PCE concentrations are below 5.64 mg/kg and returned to the site. A closure report will then be submitted.

8.7.7 Protectiveness Statement

The remedial action at BL in OU 11 (operation of the biovent system; implementation of LUC/ICs and five-year site reviews) is protective of human health and the environment, and will remain so in the future as soil remediation goals are achieved.

8.7.8 References

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URS, 1996 b. *Action Memorandum for Operable Unit 11*; Final; Environmental Restoration Program; prepared for Air Force Center for Environmental Excellence; Denver, Colorado; May 1996.

8.8 OPERABLE UNIT 12, BASEWIDE GROUNDWATER

8.8.1 Background

8.8.1.1 Site Description

OU 12 represents the basewide groundwater OU at the former Loring AFB (Figure 8.8-1). The remedy for OU 12 consolidated the LTM program into GMZs (HLA, 1999a). For organization and management purposes, groundwater plumes with common contaminant source, migration direction, and/or discharge points were grouped together into the six GMZs illustrated on Figure 8.8-2. In general, the plumes are named for the sites considered to be the source of contamination, nearby structures or geographical location. The following sections provide a description of each of the GMZs.

Groundwater Management Zone 1

GMZ 1 is located in the central portion of Loring AFB and includes groundwater plumes associated with 11 areas described below and illustrated on Figure 8.8-2:

Central Nose Dock Area (CNDA) Plume

The CNDA comprises approximately 300 acres in the central portion of Loring AFB and was used for storage, maintenance, and refueling and defueling of aircraft. CNDA included subsurface fuel lines, pumphouses, USTs, ASTs and subsurface utilities. Jet engine fuel, diesel, gasoline, hydraulic oil, heating oil, and anhydrous ammonia were stored in the tanks (HLA, 1999a).

Pumphouse 8210 (PH8210) Plume

PH8210 was located adjacent to the runway, approximately 100 ft west of the Kilo Ramp and 500 ft south of the Crash Fire Station. The pumphouse was used for the fueling of aircraft. The facility consisted of a reinforced concrete building, as well as several USTs and associated piping (HLA, 1999a).

Former Solvent Storage Building (FSSB) Plume

The FSSB was located near the northeastern corner of the Arch Hangar. The building was used to store paint thinner and solvents for aircraft maintenance. No documented spills or releases have occurred at the site, but small quantities of thinners or solvent may have been released via spillage or cleaning activities at the building (HLA, 1999a).

Jet-Engine Build-Up Shop (JEBS) North Plume

The JEBS site is described in detail in Section 8.6 of this *Report*.

ES/JEBS South Plume

The ES/JEBS site is described in detail in Section 8.6 of this *Report*.

Contractor Storage Shed (CSS) Plume

The CSS site is described in detail in Section 7.4 of this *Report*.

BL Plume

The BL site is described in detail in Section 8.7 of this *Report*.

VMB Plume

The VMB is located southeast of the intersection of Pennsylvania and Loring Commerce Rds. Waste generated at the facility included waste oil, antifreeze, solvents, Speedidry™ absorbent, and battery electrolyte. Floor drains in the buildings lead through a sand and gas trap to an underground storm drain pipe that discharged to a ponded area south of Building 7500 until 1972. At the time, the existing storm drain pipe was sealed and abandoned, and a new line was installed connecting the sand and gas trap to the sanitary sewer system. An oil/water separator and waste oil UST replaced the sand and gas trap in 1991. Surface drainage from paved areas of the site is into a drainage ditch that runs northeast to southwest across the site (HLA, 1999a).

Refueling Maintenance Shop Area (RMSA) Plume

The RMSA consists of Building 7600 and is located in the southern portion of the base. Building 7600 was constructed in 1955 and was used to perform maintenance on refueling vehicles until base closure in 1994. Building floor drains historically discharged to an oil interceptor on the eastern side of the building. The oil interceptor would conceptually allow only water to exit the structure but was dependent upon the periodic pumping of oil from the structure to function correctly. Interceptor effluent was piped to a dry well consisting of rock fragments and cobbles, constructed directly on top of the bedrock surface. The dry well was replaced with an oil/water separator in the late 1980s. Oil from the separator was piped to a UST located north of the separator. Water from the separator was routed to the drainageway until 1992, when it was piped to the sanitary sewer (HLA, 1999a).

FLDD North Plume and South Plume

The FLDD is located in the central portion of the base west of Development Drive and flows south to the East Branch Greenlawn Brook. Much of the groundwater containing the GMZ 1 contaminant plumes discharges to the FLDD area. The northern portion of the FLDD receives groundwater from the GMZ 1 sites CNDA, PH8210, FSSB, JEBS North, and ES/JEBS. The southern portion of the FLDD receives groundwater discharging from the BL, VMB and RMSA areas prior to the FLDD confluence with the East Branch Greenlawn Brook.

GMZ 2

GMZ 2 is located in the south-central portion of the base, south of the Flightline Area and west of the former East Gate of the Loring AFB (Figure 8.8-2). GMZ 2 consists of the Fuels Tank Farm (FTF). The FTF was constructed in the early 1950s for the storage of bulk fuels. Originally, three ASTs were located at the site; however, increased fuel needs prompted the construction of two additional tanks in the late 1950s. Besides storage and transfer of jet propellant fuel, motor gasoline, and No. 2 fuel oil, tank sandblasting and repainting periodically occurred at the site. Numerous quantified and unquantified fuel spills have

occurred at the FTF over the past 40 years. Additionally, leaks in underground fuel lines are a potential source of soil and groundwater contamination (HLA, 1999a).

GMZ 3

GMZ 3 is located in the western central portion of Loring AFB, east of West Branch Greenlawn Brook and includes groundwater plumes associated with 3 areas described below and illustrated on Figure 8.8-2.

Building 8711 Plume

The Building 8711 groundwater Plume includes Buildings 8710 and 8711. Building 8710 was used for equipment maintenance, weapon loading, and weapon storage. Building 8711 has a former drum storage/engine degreasing area, a former jet/missile engine testing area and a fuel bowser storage area (HLA, 1999a).

Base Exchange Service Station (BXSS) Plume

The BXSS is located at the intersection of Texas and Cupp Roads. The site includes a single building and a large paved area where leaded and unleaded gasolines were dispensed. Materials handled at the BXSS included fluids associated with vehicle maintenance such as engine oils, coolants, and lubricants. Several USTs were present at the site for storage of the various materials. Various small spills and potential leakage from tanks are the likely sources of contamination at the BXSS (HLA, 1999a).

Groundwater Management Zone 4

GMZ 4 is located in the northwestern portion of Loring AFB (Figure 8.8-2) and includes groundwater plumes associated with the former operation of the Quarry.

Quarry Plume

The Quarry is located near the northwestern boundary of Loring AFB, adjacent to the NDA. Site topography reflects past rock quarrying activities, which reportedly began with construction of Loring AFB in 1947. Quarry operations ceased in 1985. The Quarry consists

of two levels, the upper and lower tiers. The lower tier is seasonally flooded and drains through an excavated ditch into the Greenlaw Brook wetland. The lower tier rises approximately 30 ft to the upper tier, which rises approximately 30 ft toward the CNDA. Historically, waste materials from construction projects, industrial and maintenance shops, and other base activities were stored and disposed of at the Quarry (HLA, 1999a).

Groundwater Management Zone 5

GMZ 5 is located in the north-central portion of Loring AFB and consists of the FJETC Plume (Figure 8.8-2). The FJETC site is described in detail in Section 8.3 of this *Report*.

Groundwater Management Zone 6

GMZ 6 is located in the northeastern portion of Loring AFB, south-southwest of Oklahoma Rd and consists of the FTA Plume. The FTA site is described in detail in Section 8.4 of this *Report*.

Basewide Geology and Hydrogeology

Overburden Geology

Three distinct overburden units were identified during the basewide drilling program: glaciofluvial deposits, consisting of sands and gravels; till, consisting of ablation and basal till; and fill. Basal tills are finer-grained and less permeable than the more sandy, coarser-grained ablation till; however, the basal till deposits do not act as a significant confining layer to the underlying bedrock groundwater system. Except where man-made debris is observed, the fill is difficult to distinguish from the till (ABB-ES, 1997).

Bedrock Geology

The depth to bedrock across the base varies from zero to greater than 60 feet bgs. Generally, depth to bedrock is shallow near the tops of hills and knolls and increases near low-lying streams. Bedrock explorations at Loring AFB have included both cored and air hammered boreholes.

Most of the cored boreholes were relatively shallow, and typically no deeper than 100 to 125 feet bgs. Air hammered boreholes were completed to depths up to 500 feet bgs. Retrieved bedrock samples consisted of a low-grade metamorphosed pellitic limestone of the upper Carys Mills Formation. A green chloritic phyllite was encountered within the Carys Mills limestone in some borings. Core samples from boreholes contain fractures and remnant bedding planes that dip at angles ranging from horizontal to near vertical. Fractures both cross-cut and parallel bedding. Depending on location and depth, the limestone varies from very competent and lightly-fractured, to well-fractured rock; at some locations, the limestone displays a well-foliated (layered) texture (ABB-ES, 1997).

Hydrogeology

The factors that influence groundwater occurrence and movement in bedrock at Loring AFB are land-surface and bedrock-surface topography; thickness of saturated overburden; fracture orientation, frequency and connectiveness; and location and orientation of streams, drainages (potential discharge features), and regional faults. The amount of seasonal water level change in the overburden is location-dependent.

Discharge of groundwater from bedrock to the overburden groundwater system is an important component of the water balance in the shallow bedrock/overburden groundwater system at Loring AFB. Overburden groundwater is typically present in low areas or valleys in the bedrock surface, which often correspond to geologic faults and to stream channels. The flow direction of overburden groundwater (where present) is from the source area sites toward nearby surface water bodies (e.g., streams, brooks and small lakes). Where overburden groundwater approaches a stream, the component that does not discharge to the stream, flows in the direction of surface water drainage (ABB, 1997).

Evaluation of the bedrock groundwater potentiometric surface indicates that most flow is toward local watershed drainage areas (i.e., the Butterfield and Greenlaw Brook drainage systems, and the man-made East Loring Lake, rather than toward the deeper regional groundwater system represented by the Little Madawaska River and the Aroostook River. Comparison of the overburden and bedrock groundwater surface along the major drainage systems indicates that bedrock groundwater discharges to the overburden system, which in turn, discharges to the

surface water system. The direction of groundwater flow in bedrock generally coincides with the average strike direction of the principal water-bearing fractures.

A prominent north-south bedrock low is associated with the FLDD, extending from the eastern side of the NDA southward to the East Branch Greenlaw Brook. The bedrock structural zone interpreted to underlie the FLDD, has been termed the Flightline Structural Feature (FSF), and exerts an important influence on groundwater in the central portion of the Base. Based on topography and hydrogeologic information, the FSF is thought to be a structural zone composed of parallel faults and associated fractures that is highly transmissive compared to the surrounding rock. Interpreted depth of weathering from geophysical logs of water supply well AR-25 suggests that weathering is deeper within this structural zone and may, in part, be responsible for the increased transmissivity within this area. The FSF acts as a capture zone for overburden and bedrock groundwater migrating from six of the ten flow fields. The distribution of upward and downward vertical gradients within deep and shallow bedrock in the central portion of LAFB and specific capacities and yields from adjacent former water supply wells (e.g., 520 gallons per minute [gpm] for AR-25 [Roy F. Weston, 1988]) suggest the FSF is capable of accepting and transmitting large quantities of groundwater from the shallow and deeper zones in the bedrock flow system. The FSF is the dominant hydrogeologic feature in the central part of the base.

8.8.1.2 Initial Response

No remedial actions were performed pertaining to OU 12 (basewide groundwater) prior to the finalization of the *Operable Unit 12 Record Of Decision* (HLA, 1999a).

8.8.1.3 Basis for Taking Action

In December 1997, the USAF published a *Remedial Investigation Report for Operable Unit 12* (ABB-ES, 1997). The *Operable Unit 12 RI* developed a comprehensive basewide hydrogeologic conceptual model, characterized the basewide distribution and migration of contaminants in groundwater, and identified potential risk to human receptors for each flow field.

Based on the RI recommendations, the Air Force conducted an FS for areas of groundwater contamination that posed as unacceptable risk to potential receptors (HLA, 1999b). The FS developed and evaluated alternatives to remediate the contamination. A Proposed Plan (HLA, 1999c) was then prepared to document the Air Force's preferred remedial alternatives. The findings and conclusions from these site investigations are summarized below.

Groundwater Management Zone 1

The following is a description of the 11 groundwater plumes included in GMZ 1.

CNDA Plume

The CNDA plume consists of chlorinated and fuel-related VOCs in both the overburden and bedrock groundwater (HLA, 1999a).

PH8210 Plume

The Pumphouse 8210 plume consists of fuel-related VOCs, inorganic compounds, and methylene chloride, present in both overburden and bedrock groundwater, with the highest concentrations of VOCs in the source area of the bedrock plume (HLA, 1999a).

FSSB Plume

The FSSB plume consists of chlorinated VOCs in the groundwater (HLA, 1999a).

JEBS North Plume

The JEBS North plume consists of chlorinated and fuel-related VOCs. Generally, the highest concentrations of chlorinated VOCs are close to the former source areas located in the shallow bedrock zones (HLA, 1999a).

ES/JEBS South Plume

The plume associated with the ES includes contamination from a source area near the southern end of the JEBS. The JEBS South plume consists of chlorinated and fuel-related VOCs, lead and manganese (HLA, 1999a).

CSS Plume

OU 12 RI activities identified xylene and chlorinated VOCs in groundwater at this site (HLA, 1999a).

BL Plume

OU 12 RI activities identified PCE and TCE in the bedrock groundwater in the area of the BL. Contaminant distributions show a chlorinated solvent plume extending from the BL to the discharge area at the confluence of the FLDD wetland and the East Branch Greenlawn Brook (HLA, 1999a).

VMB Plume

The groundwater plume associated with the VMB includes chlorinated VOCs in bedrock groundwater. A number of fuel-related VOCs and SVOCs have also been observed in the area downgradient of the former UST at the VMB.

RMSA Plume

The groundwater plume associated with the RMSA includes chlorinated VOCs in bedrock. The RMSA bedrock groundwater plume discharges to the FLDD South Plume (HLA, 1999a).

FLDD North Plume

Many of the GMZ 1 source area plumes discharge to the FLDD area with groundwater gradient as the predominant controlling factor in plume migration. CNDA, PH8210, FSSB, JEBS North, and ES/JEBS South plumes commingle to form the FLDD North Plume. Contaminants detected in these plumes have been detected in the FLDD North plume.

FLDD South Plume

The southern portion of the FLDD receives groundwater discharging from the BL, VMB and RMSA. Controlled by groundwater gradient, these plumes commingle and discharge in to

the FLDD South and the East Branch Greenlaw Brook to form the FLDD South Plume. Contaminants detected in these plumes have been detected in the FLDD South plume.

Groundwater Management Zone 2

Both chlorinated VOCs and fuel-related compounds have been identified in FTF groundwater. However, the areas containing only fuel-related compounds are managed under the MEDEP AST/UST compliance program and are not considered in the *Operable Unit 12 LTMP, Rev. 2* (MWH, 2003).

Groundwater Management Zone 3

GMZ 3 is located in the western central portion of Loring AFB and includes 4 groundwater plumes.

Building 8711 Plume

OU 12 RI activities identified TCE and PCE in groundwater above MCLs in the vicinity of Building 8711. Concentrations of chlorinated VOCs have also been detected in groundwater in the vicinity of Building 8710 (HLA, 1999a).

BXSS Plume and Upgradient BXSS Plume

The groundwater plume associated with the BXSS includes petroleum-related contaminants in the overburden groundwater in an area west of the former gasoline UST locations. Fuel-related contamination is not regulated under CERCLA. However, because CERCLA contaminants (e.g., TCE) are present in groundwater in the vicinity of the BXSS, the BXSS Plume was included in the OU 12 FS. TCE has been identified in bedrock downgradient of the BXSS and is believed to have originated from an upgradient source, specifically Building 8710. This area of contamination is known as the Upgradient BXSS Plume.

Building 8710 was investigated as part of 1997 supplemental investigations. Building 8710 has historically been an accumulation point for hazardous materials and has been used for equipment maintenance, weapon loading and weapon storage. No definite release point was

identified; however, the floor drain inside the northwest corner of the building is suspected to be the source of the chlorinated VOCs in this area (MWH, 2004c).

Single Well Plume JBW7734

JBW7734 is located west of the CNDA and northeast of Building 8711, in the northeast portion of GMZ 3. Although the source is unknown, vinyl chloride was identified in bedrock groundwater at this location during RI activities (HLA, 1999a).

Groundwater Management Zone 4

GMZ 4 is located in the northwestern portion of Loring AFB and includes two groundwater plumes.

Quarry Plume

Groundwater contamination associated with the Quarry plume consists primarily of chlorinated VOCs; however, some fuel-related VOCs have also been detected (HLA, 1999a).

Single Well Plume JMW0401

JMW0401 is located in the northwestern portion of the CNDA, between the CNDA and the Quarry. Although the source is unknown, chrysene and manganese were identified in bedrock groundwater at this location during RI activities (HLA, 1999a).

Groundwater Management Zone 5

GMZ 5 consists of the FJETC Plume. Contaminants identified in the perched overburden groundwater at the site include primarily fuel-related VOCs and chlorinated VOCs (HLA, 1999a).

Groundwater Management Zone 6

GMZ 6 consists of the FTA Plume which is comprised of fuel-related VOCs and SVOCs detected in both overburden and bedrock groundwater. Chlorinated VOCs have also been detected in bedrock groundwater (HLA, 1999b).

8.8.2 Remedial/Removal Actions

8.8.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Operable Unit 12 Record of Decision

The *Operable Unit 12 Record Of Decision* (HLA, 1999a) documented and detailed the Limited Action and Groundwater Management Zone alternatives for remediation of groundwater within specific sites at the former Loring AFB. Table 8.8-1 summarizes the remedial alternative and target analyte lists for each of the individual sites within the OU 12 groundwater program.

8.8.2.2 Remedial Action Objectives

The *Operable Unit 12 Record Of Decision* (HLA, 199a) also documented the establishment of RAOs for the OU 12 groundwater program and documented the establishment of groundwater remediation goals for the individual GMZs that comprise the OU 12 program. The specific OU 12 RAOs established in the *Record of Decision* (HLA, 1999a) are as follows:

1) Prevent residential use of groundwater containing COCs in excess of remediation goal concentrations, or a total excess lifetime cancer risk of (ELCR) of $1x10^{-5}$ and a non-cancer hazard index of 1.

2) If feasible, reduce concentrations of COCs in groundwater to remedial goal concentrations, or a total ELCR of $1x10^{-5}$ and a non-cancer hazard index of 1.

3) Prevent COCs in excess of remediation goal concentrations, or a total ELCR of $1x10^{-5}$ and a non-cancer hazard index of 1, from migrating in groundwater past the GMZ – Groundwater Use Restriction Boundaries.

In addition to the RAOs for the OU 12 groundwater program, the *Record of Decision* also documented the completion of a Technical Impracticability (TI) Evaluation for the ES/JEBS plumes (located within GMZ-1) and the Quarry Plume (GMZ-4). The EPA has determined that a "reasonable timeframe" for restoration of groundwater within OU 12 is 100 years

(HLA, 1999a). The TI evaluations for ES/JEBS and the Quarry plumes document the cleanup times for these plumes above 100 years and indicate that it is technically impracticable from an engineering perspective to attain compliance with the OU 12 remediation goals within these plumes in the timeframe indicated by the EPA.

8.8.2.3 Remedy Description

The USAF's remedial alternatives for OU 12 included both the Limited Action (LA) alternative and the Groundwater Management Zone (GMZ) alternative, as presented in the OU 12 FS. The components of these alternatives included:

- Establishment of Groundwater Management Zones;
- Groundwater-use restrictions;
- Provision of an alternate supply of water;
- Long-term groundwater monitoring; and
- Five-year site reviews.

The major difference between the Limited Action and the Groundwater Management Zone alternatives is the number and type of long-term groundwater monitoring parameters. Both alternatives include monitoring the COCs in each plume. The Groundwater Management Zone alternative also includes monitoring of specific natural attenuation parameters. In the future, based on review of the long-term monitoring data collected, natural attenuation parameters may be added to the monitoring program for groundwater plumes for which the Limited Action Alternative is the selected remedy.

The *Operable Unit 12 Record Of Decision* (HLA, 1999a) also documented the establishment of remediation goals for groundwater associated with the various OU 12 contaminant plumes. Remediation goals have been developed for groundwater that are protective of human health. Applicable or Relevant and Appropriate Requirements (ARARs) were considered in the development of remediation goals. *The Consensus Statement for OU 12 ARARs Resolution – Groundwater Mitigation Zones* (AFBCA, 1997) identified the federal and state chemical-specific ARARs to be used for OU 12. The chemical-specific ARARs include federal and state MCLs and MEGs.

In accordance with the Consensus Statement, two sets of RGs were developed for OU 12. Remediation goals for the Contaminated Groundwater Area (i.e., plumes) are based on MCLs. Remediation goals for the Compliance Boundary are based on MCLs and MEGs. The development of remediation goals also considered the laboratory analytical method PQL, appropriate background concentration for inorganic COCs, and risk-based concentrations for COCs that do not have an MCL. The remediation goals developed for the GMZs and groundwater plumes were included in the *Operable Unit 12 Record Of Decision* (HLA, 1999a) and are summarized in Table 8.8-2. Details regarding the methodology and development of the RGs are presented in the *Operable Unit 12 Feasibility Study* (HLA, 1999b) and the *Operable Unit 12 Record Of Decision* (HLA, 1999a).

8.8.2.4 Remedy Implementation

Establishment of Groundwater Management Zones

To protect human receptors from exposure to groundwater contamination within Loring AFB, the remedy includes a groundwater use restriction component for groundwater within the affected areas of OU 12 (HLA, 1999a). The Air Force has implemented groundwater use restrictions that include prohibiting the use of groundwater within the OU 12 GMZs as a water supply currently or in the future and prohibiting any subsurface exploration, excavation, construction or subsurface discharge of groundwater within the OU 12 GMZs. To administer the groundwater use restriction portion of the remedy, the Air Force has implemented, maintained and enforced institutional controls. The institutional controls limit those activities indicated above within the OU 12 GMZs without the prior approval of the Air Force, the EPA and the MEDEP.

To assist in the implementation of this component of the remedy the Air Force has established GMZs for OU 12 to serve as boundaries for application of the use restrictions (Figure 8.8-2). Each GMZ is comprised of an area of groundwater contamination (the plume[s]), a compliance boundary, and a groundwater use restriction boundary (GMZ boundary). The compliance boundaries have been established approximately 100 to 500 feet downgradient and outside of the edges of areas of known groundwater contamination. The GMZ boundaries have been established at approximately 50 to 200 feet outside of the

compliance boundaries. These additional areas serve to provide a buffer between groundwater contamination and areas not regulated by the groundwater use restrictions established for OU 12.

The long-term monitoring activities at OU 12 include the routine monitoring of compliance boundaries to ensure that the COCs do not migrate outside the groundwater use restriction zone boundaries. The GMZ remedy indicates that a contingency action may be implemented if groundwater monitoring detects contaminants at concentrations exceeding the RGs at the compliance boundaries. Groundwater monitoring conducted at the Quarry Plume (GMZ 4) in December 1995 indicated the presence of PCE at a compliance boundary monitoring point. The Air Force subsequently implemented a contingency plan consisting of expansion of the compliance boundary and groundwater use restriction boundaries and installing new compliance boundary monitoring wells. This contingency action is documented in the *Operable Unit 4 (Landfill 2 & 3 Groundwater) & Operable Unit 12 (Quarry Plume) Explanation of Significant Differences* (AFBCA, 2001).

Establishment of an Alternate Water Supply

Because the use of groundwater will be restricted, the Air Force will assure that an alternate supply of water will be available to future transferees of property within the Groundwater-Use Restriction Boundaries until contaminant concentrations are less than the established RGs. The provision of water will be consistent with projected future land uses as identified in the Disposal ROD (AFBCA, 1996). The Air Force will determine a reasonable method for assuring water is available (e.g., the Air Force could negotiate funding support for the water supplier based on water usage, the Air Force could provide wellhead treatment within the Groundwater-Use Restriction Boundaries, the Air Force could provide bottled water or otherwise transport water to users within the Groundwater-Use Restriction Boundaries, or the Air Force could provide hookup to municipal water systems). Such assurance shall not be construed as a commitment by the Air Force to the expansion or increase in capacity of the existing water treatment and distribution system beyond that necessary to mitigate groundwater contamination concerns.

Currently, potable water for the former base and those areas within the use restriction zones is provided by the Little Madawaska River Dam Treatment Plant. This plant is operated by the LDA and is capable of providing approximately 2 million gallons per day.

Long-Term Groundwater Monitoring

An additional component of the chosen remedy for OU 12 is the performance of long-term monitoring (HLA, 1999a). Groundwater monitoring for the OU 12 program is conducted in accordance with the *Operable Unit 12 Long-term Monitoring Plan (LTMP) – Revision 3* (MWH, 2004a). The objectives of the long-term groundwater monitoring program as presented in the *Operable Unit 12 Record Of Decision* (HLA, 1999a), are to evaluate the concentrations of COCs and natural attenuation processes in groundwater to:

- Verify that groundwater containing COCs in excess of the remediation goal concentrations does not migrate past the GMZ Compliance Boundaries;
- For select plumes, assess whether lateral dispersion of contaminants is occurring to the extent which could cause migration beyond characterized lateral plume boundaries;
- Verify reduction in COC concentrations and on-going natural attenuation processes for plumes for which the GMZ alternative has been selected. Assess whether monitored plume attenuation rates are consistent with predicted attenuation rates presented in the Final OU 12 FS;
- Monitor surface water quality at selected groundwater discharge areas to confirm that these media are not being impacted by contaminated groundwater;
- Determine if the remedial alternatives are Operating Properly and Successfully (OPS) after the first two years of groundwater monitoring; and
- Determine when groundwater concentrations no longer exceed established remediation goals.

As noted previously, plumes with common origin, migration and/or discharge points have been grouped into GMZs for organization and management purposes (Figure 8.8-2). Long-term groundwater and surface water monitoring is conducted within the individual plumes to further evaluate reduction in contaminant concentrations. Additionally, monitoring is conducted at the Compliance Boundary to ensure that groundwater with contaminant

concentrations in excess of remediation goals is not migrating towards potential receptors outside the Groundwater-use Restriction Boundary. The Air Force installed and incorporated into the long-term monitoring program additional compliance boundary monitoring points for GMZ-1 and GMZ-3 to supplement the original monitoring points.

Long-term groundwater monitoring has been conducted at OU 12 on a quarterly basis (3 times per year) through 2003 at which time the monitoring frequency was reduced to semi-annually. Long-term monitoring will henceforth be conducted once per year (fall) in accordance with the *Operable Unit 12 LTMP - Revision 3* (MWH, 2004a).

The Air Force implemented a surface water sampling program in 2000 to monitor the impacts of discharging groundwater on surface water quality. The sampling is conducted once per year (August) in accordance with the *Operable Unit 12 Surface Water Sampling Quality Program Plan - Revision 2* (MWH 2005).

Five-Year Review

Five-year reviews are to be conducted at OU 12, as a component of the remedy, to evaluate the overall effectiveness of the selected remedies at providing protection to human health and the environment (HLA, 1999a). This *Five-Year Review Report* represents the second five year review performed for OU 12.

Remedy Performance

The *Operable Unit 12 Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004c) documented that the remedy for OU 12 is in place and operating as designed. The *OPS Report* also documented the progress towards attainment of the RAOs for the OU 12 long-term monitoring program established in the *ROD*. The RAOs of preventing residential use of groundwater containing COCs in excess of RGs and preventing COCs in excess of remediation goal concentrations from migrating offsite have been met. While the RAO of reducing concentrations of COCs in excess of RGs has not yet been attained, progress towards meeting this RAO has been documented in numerous reports.

Each of the components of the remedy for OU 12 (preventing residential use of contaminated groundwater, documenting reductions of COC concentrations towards RGs, preventing contaminated groundwater from moving off site and ensuring that contaminated groundwater is not negatively impacting surface water) have been successfully implemented (MWH, 2004c).

The successful implementation of these components have been documented in numerous annual reports.

A *Remedial Action Completion Report for GMZ 2* (MWH, 2002b) demonstrated all RAO had been met for GMZ 2. The USAF received approval in January 2003 from the USEPA and the MEDEP to close GMZ 2 and eliminate it from the OU12 LTM program.

The *Operable Unit 12 LTM Program 2000 Annual Report* (Montgomery Watson, 2001) documented that single well plumes JBW7734 (GMZ 3) and JMW0401 (GMZ 4) had met the remedial action objectives. Accordingly, monitoring wells JBW7724 and JMW0401 were eliminated from the OU 12 LTM program as documented in the *Operable Unit 12 LTMP, Revision 1* (MWH, 2002a).

Landuse Controls/Institutional Controls

LUC/ICs are in place for OU 12 in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (LDA) for portions of OU 12 transferred by quitclaim deed (portions of GMZ 1, GMZ 3, GMZ 4, GMZ 5 and GMZ 6). Additionally LUC/ICs are also in place for portions of GMZ 1 and GMZ 6 transferred by Federal-to-Federal agency transfer to the Bureau of Indian Affairs (BIA) and the USFWS (Figure 6-2). The Air Force also acquired a groundwater use restriction for a portion of GMZ-4 that extended beyond Air Force property onto property owned by Allagash Timberlands.

As necessary to comply with CERCLA Section 120(h), and the Loring AFB FFA (FFA, 1995), the deed of transfer and transfer agreements contain provisions restricting any activities that could jeopardize the protectiveness of the remedial action. Any such actions are prohibited without the prior approval of the Air Force, EPA, and MEDEP. The Air Force

screens and approves proposed activities that are determined to have no impact to the protectiveness of the remedial action.

The deed and property transfer agreements implemented several LUC/IC measures. These include general provisions allowing for the Air Force's continued operation of the long-term monitoring program in the future. Additional LUC/IC measures include several GMZs prohibiting use of groundwater. The LUC/ICs implemented for OU 12 are monitored and maintained in accordance with the *LUC/IC Management Plan* (AFRPA, 2004). No violations of the LUC/ICs have been documented. The LUC/ICs remain protective; no deficiencies have been identified.

8.8.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000) concluded that the remedies for OU 12 remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- The Air Force should continue to implement the major components of the remedy.
- The Air Force will develop, in consultation with EPA and MEDEP, the specific use restrictions to be included in any leases or deeds or any other property transfer documents governing transfer of any portions of Loring AFB property that are affected by the OU 12 Record of Decision. In accordance with the OU 12 Record of Decision, these restrictions will restrict certain activities within the OU 12 Groundwater Use Restriction Areas that may impact the remedy.
- An institutional control will be implemented for property owned by Consolidated Rambler Mines, located west of the Quarry. The Air Force is negotiating with the landowner to acquire a groundwater use restriction. The use restriction will run with the property until remediation is complete and agreed upon between the Air Force, the EPA and the Maine DEP. This "Deed" was expected to be finalized by June 2001.
- The BCT will revise the Compliance Boundary for GMZ 4.
- The Air Force will revise the Installation-Wide Quality Program Plan to include the additional GMZ 4 monitoring requirements.
- The USEPA will make the OU 12 OPS determination as soon as the LTM data are sufficient to support the determination.

- The Air Force will distribute the DNAPL Reduction Program, Quarry Site funds.

The Air Force has successfully implemented the components of the remedy. The successful implementation of the remedy has been documented in the following reports:

- *Operable Unit 12 LTM Program 2000 Annual Report* (Montgomery Watson, 2001)
- *Operable Unit 12 2001 Annual Report* (MWH, 2002)
- *Operable Unit 12 2002 Annual Report* (MWH, 2003)
- *Operable Unit 12 2003 Annual Report* (MWH, 2004b)
- *Operable Unit 12 Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004c)

As noted above, LUC/ICs are in place for OU 12 in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (LDA).

Additionally, as noted above the Compliance Boundary for GMZ 4 was expanded as documented in the *Operable Unit 4 (Landfill 2 & 3 Groundwater) & Operable Unit 12 (Quarry Plume) Explanation of Significant Differences* (AFBCA, 2001).

An agreement was reached with Allagash Timberlands (formerly Rambler Mines) to institute the groundwater use restriction for GMZ 4 on the property west of the Quarry in 2003. The use restriction for the property incorporates the groundwater and landuse restrictions associated with all GMZs for OU 12.

The Installation-Wide Quality Program Plan (IWQPP) has been revised several times since the *First Five-Year Review Report* (AFBCA, 2000) and incorporates the additional GMZ 4 monitoring requirements. The current version of the IWQPP is the *Installation-Wide Quality Program Plan Version 6* (MWH, 2004c).

As noted above, the *Operable Unit 12 Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004c) was completed in September 2004.

In 2002, the MEDEP conducted a pilot study with funding from EPA and the Air Force to investigate the effectiveness of steam injection to remediate chlorinated VOCs. The steam injection pilot test ended in November, 2002.

This *Five-Year Review Report* documents the second review for the OU 12 long-term monitoring program.

8.8.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.8.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

As documented in the *Operable Unit 12 Demonstration of a Remedial Action Operating Properly and Successfully* (MWH, 2004c), the RAOs for OU 12 of preventing use of groundwater containing COCs in excess of remediation goal concentrations and preventing COCs in excess of remediation goal concentrations from migrating offsite have been met. While the RAO of reducing concentrations of COCs in groundwater to remedial goal concentrations has not been fully attained, the chosen remedy is protective of human health and the environment and facilitating the additional attainment of this RAO.

No Further CERCLA Action is necessary for groundwater associated with the PH 8270 site and the DP site, and portions of the NDA and FTF sites. No Further CERCLA Action is necessary because CERCLA contaminants are not present at concentrations that pose an unacceptable risk under CERCLA to human health and ecological receptors. The petroleum-related contamination remaining at these source areas is not regulated under CERCLA. This petroleum-related contamination has been addressed in accordance with applicable state requirements (i.e., MEDEP Chapter 691, Rules for Underground Oil Storage Facilities; and MEDEP Procedural Guidelines for Establishing Standards for the Remediation of Soil and Groundwater). The No Further CERCLA Action decision for groundwater associated with

these source areas does not constitute a finding by the USEPA that adequate protection has been achieved at these source areas. However, proper ICs, including the establishment of groundwater use restrictions, have been implemented for the No Further CERCLA Action areas. These ICs protective of human health and the environment.

8.8.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater remediation goals in the *OU 12 Record of Decision* were based on ARARs, except where ARARs were not available. Remediation goals for the Contaminated Groundwater Areas of OU 12 (i.e., plumes) are based on Federal Safe Drinking Water Act MCLs. Remediation goals for the Compliance Boundary are based on Federal Safe Drinking Water Act MCLs and the State of Maine MEGs. Of the RGs established for groundwater under the OU 12 long-term monitoring program, ARARs were used for all COCs except 4-methyl-2-pentanone, manganese and lead for which risk-based concentrations were developed. ARARs did not exist for these constituents.

The ARARs for OU 12 remain current with the exception of arsenic. On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 µg/l to 10 µg/l). Groundwater monitoring during the OU 12 RI process included analysis for arsenic concentrations, and a background value of 2 µg/l was established for groundwater at the former Loring AFB (HLA, 1999c). Detections of arsenic above the former MCL of 50 µg/l were limited and arsenic was determined not to be a COC for groundwater at the former Loring AFB.

A review of the historical data collected during the RI process indicates that detections above the new MCL of 10 µg/l were infrequent and limited to a couple of locations where active biodegradation of VOCs is suspected to have affected groundwater geochemistry such that arsenic has been mobilized. These locations are located within the boundaries of the OU 12 GMZs. Arsenic is not considered a chemical released to the environment during routine base activities at the Loring AFB, but rather it is a byproduct of the processes of natural attenuation of constituents historically released into groundwater.

It is expected that the OU 12 remedy will remain protective of human health and the environment with respect to arsenic with the institution of the new ARAR for arsenic. Long-term monitoring of groundwater and groundwater use restrictions protect receptors at the compliance boundaries and restrict the usage of groundwater within the GMZs. Should long-term monitoring of groundwater at the compliance boundary points indicate that constituents released to the environment during Loring AFB activities are moving offsite and that natural attenuation of those constituents could result in elevated arsenic offsite, the potential offsite impacts would be evaluated. No such concern is indicated at this time.

Changes in Exposure Pathways: Since completion of the last Five Year Review, additional guidance, including EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November, 2002), have been developed to aid in evaluating the potential for human exposure from this pathway. The Air Force will consider this and any other appropriate guidance to determine if the vapor intrusion pathway for various GMZ-1 and GMZ-3 plumes requires additional analysis.

Changes in Toxicity and Other Contaminant Characteristics: Human health risk-based concentrations were used to establish remediation goals for iron, manganese, and 4-methyl-2-pentanone (Table 8.8-2). A review of toxicity factors showed that the values have not changed since establishment of the remediation goals.

In addition to the constituents for which remediation goals were calculated, several others were identified as COPCs in the human health risk assessment. Recent changes in toxicity values for some COPCs could result in total estimated risk that exceeds the target risk levels. Therefore, toxicity factors for all COPCs were evaluated to identify changes in values used in the risk assessment versus values currently available. Table 7.3-2 lists all COPCs identified in groundwater at the Loring Air Force Base for which toxicity factors have changed. Toxicity factors remain unchanged for all other COPCs not listed in Table 7.3-2. Among the COPCs identified at OU 12 (listed in Table MM-4 in the RI), toxicity factors have changed for a number of COPCs. For carcinogenic risks, cleanup levels were developed for COPCs that contributed to a risk in excess of 1×10^{-6}, leading to a total risk in exceedance of 1×10^{-4}, when contribution from all COPCs was considered. Therefore, carcinogenic risks

did not exceed 1 x 10^{-6} for COPCs not listed in Table 7.3-2. Carcinogenic toxicity factors are linearly related to risk, i. e, an increase in toxicity value results in an equal increase in risk. Therefore, any increase in a carcinogenic toxicity factor that is less than 100, will not affect the target risk of 1 x 10^{-4}. TCE and benzene are the only COPCs for which carcinogenic toxicity factors are higher than that used during the risk assessment. Because the toxicity factors are higher by factors of 40 and 2 for trichloroethene and benzene, respectively, estimated risks using currently available toxicity factors will not significantly add to the total risks. Also, the toxicity factors for TCE have been withdrawn from EPA's IRIS database, and the new values have not been included. In addition, the final RG selected for TCE in the ROD was based on the MCL, which has not changed. Therefore, the cleanup standards for carcinogenic COPCs remain protective.

Currently available toxicity factors are lower than those used in the risk assessment for several COPCs for which RGs were not established in the RI. Therefore, estimated risks will be higher for beryllium, chlordane, chromium, 2-methylnaphthalene, naphthalene, phenol, trichloroethene, and xylenes if these current values are used. The calculated noncarcinogenic risks for these compounds presented in the risk assessment were reviewed to determine the impact of currently available values. Estimated noncarcinogenic risks will be impacted if currently available toxicity factors for 2-methylnaphthalene, trichloroethene, and xylenes are used. Calculated noncarcinogenic risks due to exposure to these COPCs will exceed a total HI=1 at several areas within OU 12 if current toxicity values are used. However, the cleanup standard for TCE selected in the ROD is based on the MCL, which has not changed. In addition, cleanup standards are rarely developed based on noncarcinogenic risks because of uncertainties associated with estimation of such risks. Therefore, although noncarcinogenic risks may exceed one, development of cleanup standards for 2-methylnaphthalene and xylene is not warranted.

In addition, toxicity factors are currently available for several compounds that did not have toxicity factors at the time of the RI. These include 1,2-dibromomethane, n-nitrosodiphenylamine, 1,1,2,2-tetrachloroethane, and vinyl chloride. Estimated noncarcinogenic risks due to exposure to these compounds, with the exception of vinyl chloride, will not be significant if currently available toxicity factors are used. However,

noncarcinogenic risks due to exposure to vinyl chloride will exceed hazard quotient of one at several areas within OU 12 if the currently available toxicity factor is used. However, the RG selected for vinyl chloride in the ROD is based on the MCL, which has not changed. Therefore, the cleanup standards listed in Table 8.8-2 are conservative and remain protective.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any significant change in EPA guidance, which could result in significant revisions to the cleanup goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and changes in guidance that have occurred would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy for OU 12 is expected to meet each of the RAOs, based on observed indicators that natural attenuation processes are reducing contaminant mass of COCs in groundwater, the successful implementation of LUC/ICs and the continued performance of long-term monitoring.

8.8.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.8.4.4 Technical Assessment Summary

As described above, the remedy at OU 12 is functioning as intended by successful establishment of Groundwater Management Zones; groundwater-use restrictions; availability

of an alternate supply of water; long-term groundwater monitoring; and five-year site reviews. Additionally, LUC/IC are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, and no other information has come to light that would call into question the protectiveness of the remedy.

8.8.5 Issues

No issues were identified for OU 12.

8.8.6 Recommendations and Followup Actions

Routine long-term monitoring and reporting of basewide groundwater quality under the OU 12 long-term monitoring program should continue. Routine monitoring for OU 12 should also include monitoring of LUC/ICs to document their continued effectiveness.

8.8.7 Protectiveness Statement

The remedial action at OU 12 (establishment of Groundwater Management Zones; groundwater-use restrictions; provision of an alternate supply of water; long-term groundwater monitoring; and five-year site reviews) is protective of human health and the environment, and will remain so in the future as groundwater remediation goals are achieved.

8.8.8 References

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8.9 OPERABLE UNIT 13, BASEWIDE SURFACE WATER, SEDIMENT AND FISH TISSUE

8.9.1 Background

8.9.1.1 Site Description

OU 13 represents the basewide surface water, sediment, and associated biological communities at the former Loring AFB located in Limestone, Maine (Figure 8.9-1). Operable Unit 13 includes brooks, streams, ditches, lakes, ponds, and wetlands in approximately 30 square miles (19,2590 acres) of watershed. Because of the size of the area and the number of drainage systems involved, Operable Unit 13 was subdivided into three primary study areas (Woodlot Alternatives [Woodlot], 2004).

The study areas are the three major watersheds that comprise the geographic area in and surrounding the LAFB and include:

- Wolverton Brook/Brandy Brook Study Area
- Greenlaw Study Area
- Butterfield Brook/Limestone Stream Study Area

The study areas are shown on Figure 8.9-2. A brief description of each study area is provided below.

Wolverton Brook/Brandy Brook (WB/BB) Study Area

These brooks receive runoff from the western portion of Loring AFB as well as off-base areas west of the base, and flow southwesterly into Little Madawaska River (LMR). The LMR is a relatively broad but shallow river located approximately 1.5 miles west of the base boundary. The LMR flows south approximately 7 miles and merges with the Aroostook River.

Greenlawn Brook (GB) Study Area

Greenlawn Brook, the principal on-base drainage, consists of the East Branch and West Branch (EBGB and WBGB), which merge and flow southwesterly into the LMR. The

FLDD and the FLDD Wetland constitute a tributary to the EBGB, which receives runoff and storm drain discharge from the primary operations areas of the base. The EBGB originates in a wetland south of the FTF and flows westerly approximately 2,500 feet before merging with the WBGB. The WBGB originates in a wetland north of the Flightline Area, west of the base boundary. The WBGB flows southward onto base property, passing west of the NDA and into Malabeam Lake, a distance of approximately 2 miles. The WBGB flows out of the southern end of Malabeam Lake, continues southward into Chapman Pit, and then flows south to the confluence with the EBGB.

Butterfield Brook/Limestone Stream (BB/LS) study Area:

The headwaters of the BB are north of the base boundary. BB drains approximately the eastern third of the base, flows southeasterly into Durepo Reservoir, and becomes Limestone Stream below the reservoir dam. Limestone Stream flows south approximately 11 miles and merges with the Aroostook River in New Brunswick, Canada.

8.9.1.2 Initial Response

A Fish Advisory was issued by the Maine Department of Human Services (DHS) in May 1996 warning against ingestion of fish from certain water bodies within and around the former Loring AFB. The areas included Chapman Pit, Green Pond, Greenlaw Brook, and the LMR and its tributaries from the Madawaska Dam Reservoir south to the Aroostook River (AFBCA, 2000).

A time-critical removal action was completed in 1996 that included removal of PCB-contaminated sediment from Ditch G12; removal of soil and sediment from Ditch G11; and cleaning of storm drains and catch basins from the Steam Plant to the head of Ditch G12 (located in the south-central portion of the base) (AFBCA, 2000).

8.9.1.3 Basis for Taking Action

Little is known of the specific sources of contamination in OU 13. Much of the contamination was likely due to non-point source releases from base and non-base related activities. The RI process, performed from 1988 to 1996, focused on assessing current conditions and hazards. This section will summarize the detected contaminants and describe

the pre-remedial response activities taken by the Air Force upon evaluation of the nine years of soil, surface water, biological tissue and sediment data documented in the *Operable Unit 13 Remedial Investigation Report* (ABB-ES, 1997a).

Wolverton Brook/Brandy Brook Study Area

The *Operable Unit 13 Remedial Investigation Report* (ABB-ES, 1997a) documented historical contamination detected in the WB/BB Study Area unrelated to base activities, in the form of pesticides and fuel-related contaminants also detected in the WB/BB Study Area at off-site sampling locations upstream of base influences. The likely source of non-base-related pesticide contamination was runoff from local agricultural fields. Runoff from roads and land where farm machinery was used and repaired was the likely source of fuel-related contamination.

Greenlaw Brook Study Area

The primary contaminants detected in the FLDD and FLDD Wetland include PAHs, PCBs, pesticides, TPH, and lead. The primary contaminants in the EBGB include PAHs, PCBs, pesticides, TPH, and lead. PCBs have also been detected in fish tissue in the EBGB. Contaminants detected in the WBGB are predominantly the result of base-related activities; however, some potential exists for non-base-related contaminants to also enter the WBGB. The primary contaminants in the WBGB, specifically in the NDA drainageways that originate on the western side of the NDA, include PAHs and inorganics (ABB-ES, 1997b).

Butterfield Brook/Limestone Stream Study Area

Contaminants detected within the study area are a result of a combination of base- and non-base-related activities. Butterfield Brook and its northern tributaries are believed to be impacted by runoff from agricultural field activity north of the base (ABB-ES, 1997b).

8.9.2 Remedial/Removal Actions

8.9.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Operable Unit 13 Record of Decision

The *Operable Unit 13 Record Of Decision* (ABB-ES, 1997b) documented the remedy for OU 13 of both Removal and Disposal and No Further CERCLA Action. No Further CERCLA Action was deemed necessary for much of OU 13 because no unacceptable risk to human health or the environment was identified.

8.9.2.2 Remedial Action Objectives

The *Operable Unit 13 Record Of Decision* (ABB-ES, 1997b) documented the establishment of RAOs for the OU 13 program and documented the establishment of sediment and fish tissue remediation goals for the individual study areas that comprise the OU 13 program. The OU 13 RAOs are as follows:

- Prevent or minimize ingestion of and dermal contact with contaminated soil/sediment by human and ecological receptors;
- Prevent human ingestion of contaminated fish;
- Minimize migration of contaminated soil/sediment; and
- Avoid destruction of existing ecological habitat where the risk associated with short-term habitat loss outweighs the reduction in risk potentially realized by site remediation.

The OU 13 RGs are listed in Table 8.9-1.

8.9.2.3 Remedy Description

The Removal Action remedy included disposal for areas within OU 13 exceeding RGs. These areas include:

- FLDD;
- FLDD Wetland;
- EBGB;
- EBGB Wetland
- NDA Drainageways (north and south);
- Ditch G06;
- Underground Transformer Site (UTS) Wetland (northern portion).

The State Fish Advisory, implemented in 1996, will continue to be enforced until the fish are determined to be acceptable for consumption. Areas covered by the advisory include Chapman Pit, Green Pond, Greenlaw Brook, and the LMR and its tributaries from the Madawaska Dam Reservoir south to the Aroostook River.

The No Further CERCLA Action alternative was selected for the LMR because there was no unacceptable risk associated with surface soil, sediment, and surface water. The No Further CERCLA Action alternative includes an environmental monitoring program and five-year site reviews to assess whether human health and the environment continue to be adequately protected.

8.9.2.4 Remedy Implementation

Removal and Disposal Action

The Removal and Disposal Actions for OU 13 were initiated in late 1997 and were completed in 1998. The 1997 remedial actions consisted of sediment removals in the FLDD, the FLDD Wetland, Drainage Ditch G12, the EBGB , EBGB Wetland, two drainage ditches west of the NDA, and a wetland south of the former Underground Transformer Site (UTS). Sediment removal in Drainage Ditch G06 was also anticipated; however, pre-design sampling indicated there was no unacceptable risk to receptors, and remediation was unnecessary. OU 13 sediment remedial actions (i.e., EBGB) at Loring AFB were completed during the 1998 construction season. Compensatory mitigation was initiated to restore over 35 acres of wetlands excavated during the removal of contaminated sediments.

Monitoring

Implementation of the OU 13 LTM Program was initiated in 2001. In 2001, the OU 13 LTM sampling and analysis was completed in accordance with the OU 13 Long-Term Monitoring Plan (HLA, 1998). PCB concentrations were detected in fish tissue above the OU 13 fish tissue monitoring goal; therefore, additional sediment sampling and analysis was performed along the FLDD/EBGB in 2002. Sediment sampling was conducted within the FLDD/EBGB restoration area and downstream of the former LAFB boundary. Based on the 2002 sediment

sampling and analysis results, only one sample detected PCBs slightly above the OU 13 remediation goal.

As recommended in the *OU 13 2001 Long-Term Monitoring Report* (Woodlot, 2002) and approved by the EPA and MEDEP, the focus of OU 13 efforts in 2003 was to gather additional information regarding pesticide and PCB concentrations in fish tissue, and sediment at the areas included in the OU 13 LTM Program, at the areas not influenced by Air Force activities (i.e., background locations), and at historically sampled waterbodies that may have been inadequately characterized due to high laboratory detection limits.

Results from the 2003 OU 13 monitoring confirmed PCB concentrations in fish tissue were elevated above the OU 13 monitoring goal and established pesticide and PCB background concentrations in fish tissue. Results of the OU 13 2003 sampling and analysis were presented in the *OU 13 2003 Monitoring Report* (Woodlot, 2004). Based on the results of OU 13 LTM in 2001 through 2003, the AFRPA, EPA, and MEDEP agreed that the OU 13 LTM Plan would be revised to document required revisions to the OU 13 LTM Program. A Draft revised OU 13 LTM Plan was issued to MEDEP and EPA in April 2005; however, Maine Bureau of Health (MBOH) is currently considering revising fish consumption advisory action levels. These revised action levels will be reviewed prior to initiating future OU 13 LTM, which is currently scheduled for 2008.

Subsequent to the OU 13 removal actions in 1997/1998, the wetland mitigation/restoration component of OU 13 was transferred to the Loring Wetlands Management Program. Wetland mitigation monitoring was initiated in 1998. Wetland mitigation monitoring includes monitoring vegetation, wildlife, soil, wetland hydrology, and wetland functions and values. Results from the 2004 wetlands monitoring indicate each area has met or will meet the site specific mitigation goals and objectives.

8.9.3 Implementation of Recommendations from Last Five-Year Review

The *First Five-Year Review Report* (AFBCA, 2000), concluded that the remedies for OU 13 remained protective of human health and the environment. The following recommendations were included in the *First Five-Year Review Report* (AFBCA, 2000):

- Long-term wetlands and environmental monitoring in accordance with the OU 13 LTM Plan (HLA, 1998) and the Wetlands Mitigation Plans should be continued.

The environmental monitoring component of the No Further CERCLA Action remedy has been successfully implemented and has been documented in the following reports:

- Wetlands Monitoring 1999 Annual Report. (Woodlot, 2000)
- Wetlands Monitoring 2000 Annual Report. (Woodlot, 2001)
- Wetlands Monitoring 2001 Annual Report. (Woodlot, 2002)
- 2001 OU 13 Long-Term Monitoring Report. (Woodlot, 2002)
- Wetlands Monitoring 2002 Annual Report. (Woodlot, 2003)
- Wetlands Monitoring 2003 Annual Report. (Woodlot, 2004)
- 2003 OU 13 Long-Term Monitoring Report. (Woodlot, 2004)
- Wetlands Monitoring 2004 Annual Report. (Woodlot, 2005)

8.9.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

8.9.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The Air Force has successfully implemented the components of the remedy. The Removal Actions were completed as noted above. The environmental monitoring component of the No Further CERCLA Action remedy has been successfully implemented and documented in numerous reports, and the chosen remedy is protective of human health and the environment and facilitating the attainment of the RAOs.

8.9.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: ARARs do not exist for sediment and soil within OU 13. Site-specific, risk-based remediation goals were developed to be protective of human health and the environment.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Risk-based sediment and surface soil remediation goals were established for several compounds including PAHs, DDD, DDE, DDT, endrin, Aroclor-1260, chlordane, lead and zinc. The standards were developed to protect both human health and the environment. Protection of human health was based on the lesser value of a carcinogenic risk based concentration calculated with the cancer risk set at 1×10^{-6} and a noncarcinogenic risk based concentration with the hazard quotient set at one. Remediation goals selected under the ROD represent the lesser of the human health and ecological criteria.

Changes in toxicity values since the time of the ROD could affect the protectiveness of the remediation goals. Review of toxicity factors for this *Five-Year Review Report* showed that the carcinogenic oral toxicity factors for Aroclor-1260 and the PAHs have decreased, while inhalation slope factors are higher. For chlordane, oral and inhalation factors are lower than those used in the risk assessment. Because of these toxicity factor revisions, carcinogenic risk estimates for these constituents are expected to be lower than those reported in the risk assessment. Consequently, the remediation goals continue to be protective for carcinogenic risks.

Changes in noncarcinogenic toxicity values were also reviewed. The noncarcinogenic reference dose for Aroclor-1260 is not currently available, while a value of 2×10^{-5} was used in the risk assessment. Therefore, noncarcinogenic hazard due to Aroclor 1260 would be lower. Noncarcinogenic risk due to exposure to chlordane would increase. However, the

remediation goals remain protective overall because human health risk based remediation goals were developed based on carcinogenic risks.

In addition, fish tissue action levels, based on protection of human health, were established for DDD, DDE, DDT, Aroclor 1242, Aroclor 1260, heptachlor, and chlordane. For this exposure pathway involving human consumption of fish, only the oral toxicity factors affect estimated risks. Review of toxicity factors showed that the carcinogenic oral toxicity factors for Aroclor-1260, Aroclor-1242, and chlordane have decreased. Using currently available values, carcinogenic risk estimates for these constituents are expected to be lower than those reported in the risk assessment. Consequently, the remediation goals remain protective.

In addition to the constituents for which remediation goals were calculated, several others were identified as COPCs in the human health risk assessment. Changes in toxicity values for these COPCs could potentially result in total estimated risk that exceeds the target risk level established in the risk assessment. Therefore, toxicity factors for all COPCs were evaluated to identify changes in values used in the risk assessment versus values currently available. Table 7.3-2 lists all COPCs identified in surface soil, sediment, and fish tissue for which oral toxicity factors have changed. Table 8.3-2 lists inhalation toxicity factors that have changed. Toxicity factors remain unchanged for all other COPCs not listed in Table 7.3-2 or Table 8.3-2.

Among the COPCs identified at OU-13, toxicity factors have changed for a number of COPCs. Since the time of the risk assessment, carcinogenic oral toxicity factors have not increased for any of the COPCs. Inhalation toxicity factors were higher for few COPCs. However, estimated risks using currently available toxicity factors would not significantly add to the total risks. The remediation goals for carcinogenic COPCs remain protective.

For noncarcinogenic risks, currently available toxicity factors are higher for several COPCs. The calculated noncarcinogenic risks for these compounds were checked to determine impact of currently available values. Estimated noncarcinogenic risks would not be impacted if currently available toxicity factors for all these compounds are used.

In addition, several compounds currently have toxicity factors available that were not available at the time of the risk assessment. Estimated noncarcinogenic risks due to exposure to these compounds would not be significant if currently available toxicity factors are used.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. The toxicity factors used in the ecological risk assessment are considered protective of the environment.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA Headquarters and EPA Region 1 guidance. There has not been any significant change in EPA guidance, which could result in significant revisions to the remediation goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and changes in guidance would not result in significant revisions to remediation goals.

Expected Progress Toward Meeting RAOs: The RAOs for OU 13 that address contaminated sediment and restoration of wetlands have been met through removal actions and wetland construction. The RAO for OU 13 that addresses preventing the human ingestion of contaminated fish has also been met through the implementation of the fish consumption advisory.

8.9.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.9.4.4 Technical Assessment Summary

As described above, the remedy at OU 13 is functioning as intended by successful removal of contaminated sediment and implementation of long-term environmental monitoring as well

as five-year site reviews to assess whether human health and the environment continue to be adequately protected. The remedy is currently functioning as intended, and no other information has come to light that would call into question the protectiveness of the remedy.

8.9.5 Issues

No issues were identified for OU 13.

8.9.6 Recommendations and Follow-up Actions

The *OU 13 Long-term Monitoring Plan* should be revised to reflect the changes to the LTM program agreed upon during the May 2004 BCT meeting. Additionally, a review of the status of the MBOH fish tissue action levels and recommended PCB analysis should be conducted prior to performing the 2008 OU 13 LTM to be conducted in 2008.

8.9.7 Protectiveness Statement

The remedial action at OU 13 (removal action of contaminated sediment, environmental monitoring and five-year site reviews) is protective of human health and the environment, and will remain so in the future.

8.9.8 References

ABB-ES, 1997a. *Basewide Surface Water/Sediment Operable Unit (OU-13) Remedial Investigation Report*; Final; Installation Restoration Program; prepared for HAZWRAP; Portland, Maine; April 1997.

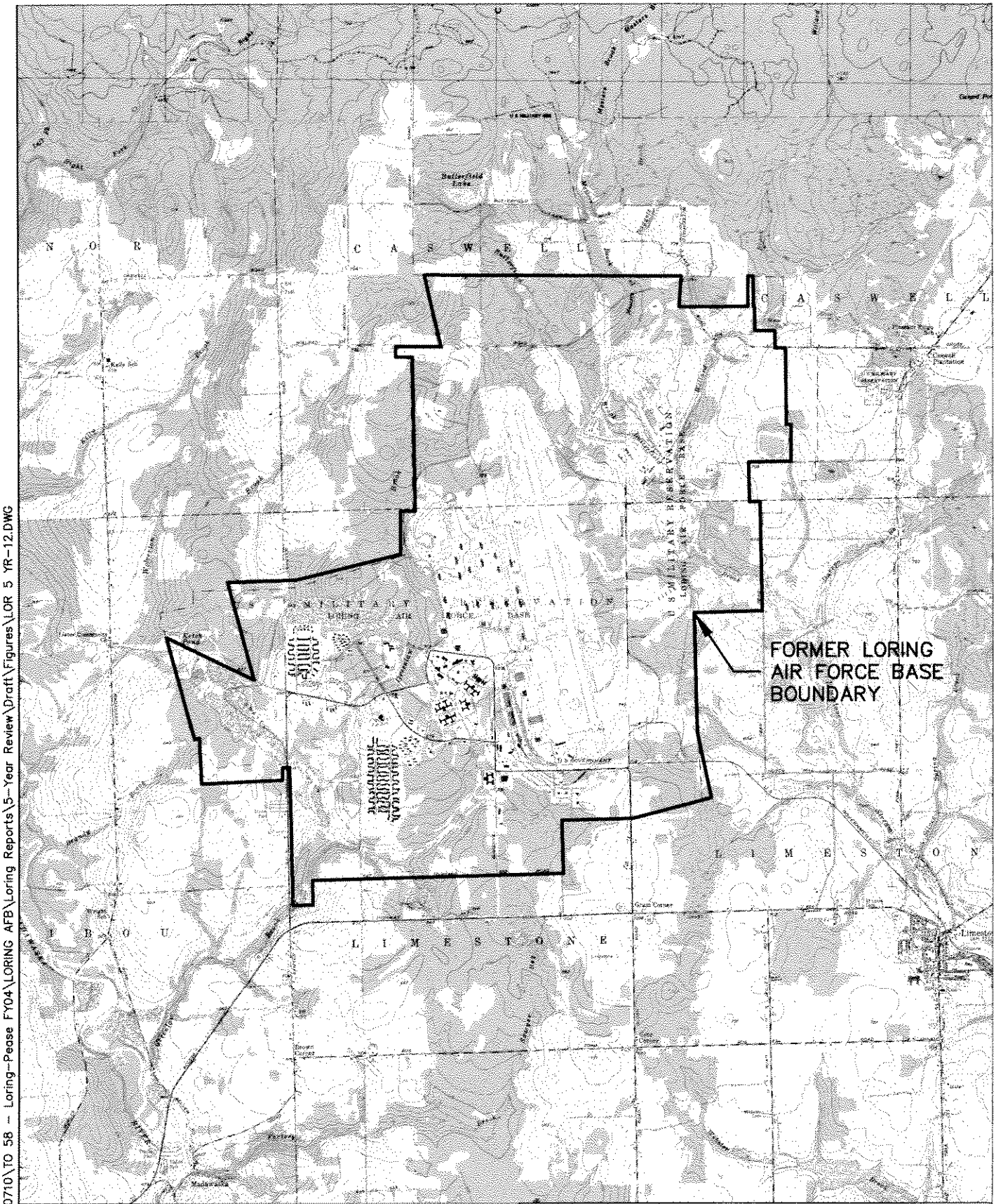
ABB-ES, 1997b. *Basewide Surface Water/Sediment OU-13 Record of Decision*; Final; Installation Restoration Program; prepared for HAZWRAP; Portland, Maine; May 1997.

AFBCA, 2000. *First Five-Year Review Report for Loring Air Force Base*. September 2000.

AFRPA, 2004. *Land Use Control/Institutional Control Management Plan, Loring Air Force Base, Maine.* October, 2004.

Woodlot Alternatives (Woodlot). 2004. *Operable Unit 13 2003 Annual Report*. March, 2004.

FIGURES



SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

SITE LOCATION MAP

MWH

FIGURE 5-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-12.DWG

OPERABLE UNIT

AREA REGULATED UNDER MEDEP CMR CHAPTER 691
RESTRICTED FROM GROUNDWATER USE WITHOUT PERMISSION FROM MEDEP/AF

GROUNDWATER MANAGEMENT ZONE UNDER CERCLA
RESTRICTED FROM GROUNDWATER USE WITHOUT PERMISSION FROM EPA/MEDEP/AF

FORMER LORING AFB PROPERTY BOUNDARY

MAGNETIC NORTH

TRUE/ME STATE GRID NORTH

LAFB GRID NORTH

OU 5

OU 8

OU 9

OU 10

OU 11

OU 2 AND OU 4

FJETC GMZ (GMZ 5)

EAST BASE GMZ (GMZ 6)

QUARRY GMZ (GMZ 4)

BXSS GMZ (GMZ 3)

INDUSTRIAL AREA GMZ (GMZ 1)

FTF SOUTH GMZ (GMZ 2)

LANDFILLS GMZ

NOSE DOCK AREA GROUNDWATER USE RESTRICTION ZONE

EAST BASE GROUNDWATER USE RESTRICTION ZONE

NORTH WHERRY GROUNDWATER USE RESTRICTION ZONE

SOUTH WHERRY GROUNDWATER USE RESTRICTION ZONE

DRMO GROUNDWATER USE RESTRICTION ZONE

ALERT AREA GROUNDWATER USE RESTRICTION ZONE

SOUTH FLIGHT LINE GROUNDWATER USE RESTRICTION ZONE

NOTES:

1. OU 3 - DEBRIS DISPOSAL AREAS ARE LOCATED AT SEVERAL LOCATIONS ACROSS THE BASE.
2. OU 12 - BASEWIDE GROUNDWATER INCLUDES THE RESTORATION OF GROUNDWATER THROUGHOUT THE MAJORITY OF THE BASE.
3. OU 13 - BASEWIDE SURFACE WATER AND SEDIMENT INCLUDES ALL SURFACE DRAINAGE FEATURES OF THE BASE.

0 2500 5000 ft

BASE SOURCE:
FIGURE 4-1, GMZs AND PLUMES, FILE NO. T:\2992-21\2992G10A.DWG, FROM THE FINAL LORING AFB OU-12 LTM PLAN PREPARED BY HAZWRAP, NOVEMBER 1999.

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FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE,
LIMESTONE, MAINE

OPERABLE UNITS

MWH

FIGURE 5-2

MAGNETIC NORTH

TRUE/ME STATE GRID NORTH

LAFB GRID NORTH

C

FJETC SITE

FJETC GMZ (GMZ 5)

OU 8

EAST BASE GMZ (GMZ 6)

EAST BASE GROUNDWATER USE RESTRICTION ZONE

EXPLOSIVE ORDNANCE DISPOSAL RANGE SITE

E

OUTDOOR FIRING RANGE SITE

C-1

ALLAGASH TIMBERLAND PARCEL

UMPI PARCEL

OU 5

NOSE DOCK AREA GROUNDWATER USE RESTRICTION ZONE

QUARRY GMZ (GMZ 4)

NORTH WHERRY GROUNDWATER USE RESTRICTION ZONE

F

DRMO GROUNDWATER USE RESTRICTION ZONE

LANDFILLS GMZ

E-1

BXSS GMZ (GMZ 3)

B-6

B-7

B-1

B-2

INDUSTRIAL AREA GMZ (GMZ 1)

OU 10

A

ES/ JEBS SITE

B-5

B-3

AUTO HOBBY SHOP SITE

B-4

CONTRACTOR STORAGE SHED SITE

OU 2 AND OU 4

OU 9

SOUTH FLIGHT LINE GROUNDWATER USE RESTRICTION ZONE

ALERT AREA GROUNDWATER USE RESTRICTION ZONE

BASE LAUNDRY SITE

E

F

SOUTH WHERRY GROUNDWATER USE RESTRICTION ZONE

E-1

OU 11

FTF SOUTH GMZ (GMZ 2)

D-1 3

D-1 4

F-2

D

F-1

D-1 1

D-1 2

- OPERABLE UNIT
- IRP SITE
- AREA REGULATED UNDER MEDEP CMR CHAPTER 691
  RESTRICTED FROM GROUNDWATER USE WITHOUT PERMISSION FROM MEDEP/AF
- GROUNDWATER MANAGEMENT ZONE UNDER CERCLA
  RESTRICTED FROM GROUNDWATER USE WITHOUT PERMISSION FROM EPA/MEDEP/AF
- FORMER LORING AFB PROPERTY BOUNDARY
- DEFENSE FINANCE AND ACCOUNTING SERVICE (DFAS) PARCEL (A)
- JOB CORPS PARCELS (B-1 THROUGH B-7)
- MAINE ARMY NATIONAL GUARD (MEARNG) PARCELS (C, C-1)
- BUREAU OF INDIAN AFFAIRS (BIA) PARCELS (D, D-1)
- US FISH AND WILDLIFE SERVICE (USFWS) PARCELS (E, E-1)
- LORING DEVELOPMENT AUTHORITY (LDA) PARCELS (F, F-1, F-2)

NOTES:

1. OU 3 - DEBRIS DISPOSAL AREAS ARE LOCATED AT SEVERAL LOCATIONS ACROSS THE BASE.
2. OU 12 - BASEWIDE GROUNDWATER INCLUDES THE RESTORATION OF GROUNDWATER THROUGHOUT THE MAJORITY OF THE BASE.
3. OU 13 - BASEWIDE SURFACE WATER AND SEDIMENT INCLUDES ALL SURFACE DRAINAGE FEATURES OF THE BASE.

0 750 1500 2250 3000 ft

BASE SOURCE:
FIGURE 4-1, GMZs AND PLUMES, FILE NO. T:\2992-21\2992G10A.DWG, FROM THE FINAL LORING AFB OU-12 LTM PLAN PREPARED BY HAZWRAP, NOVEMBER 1999.

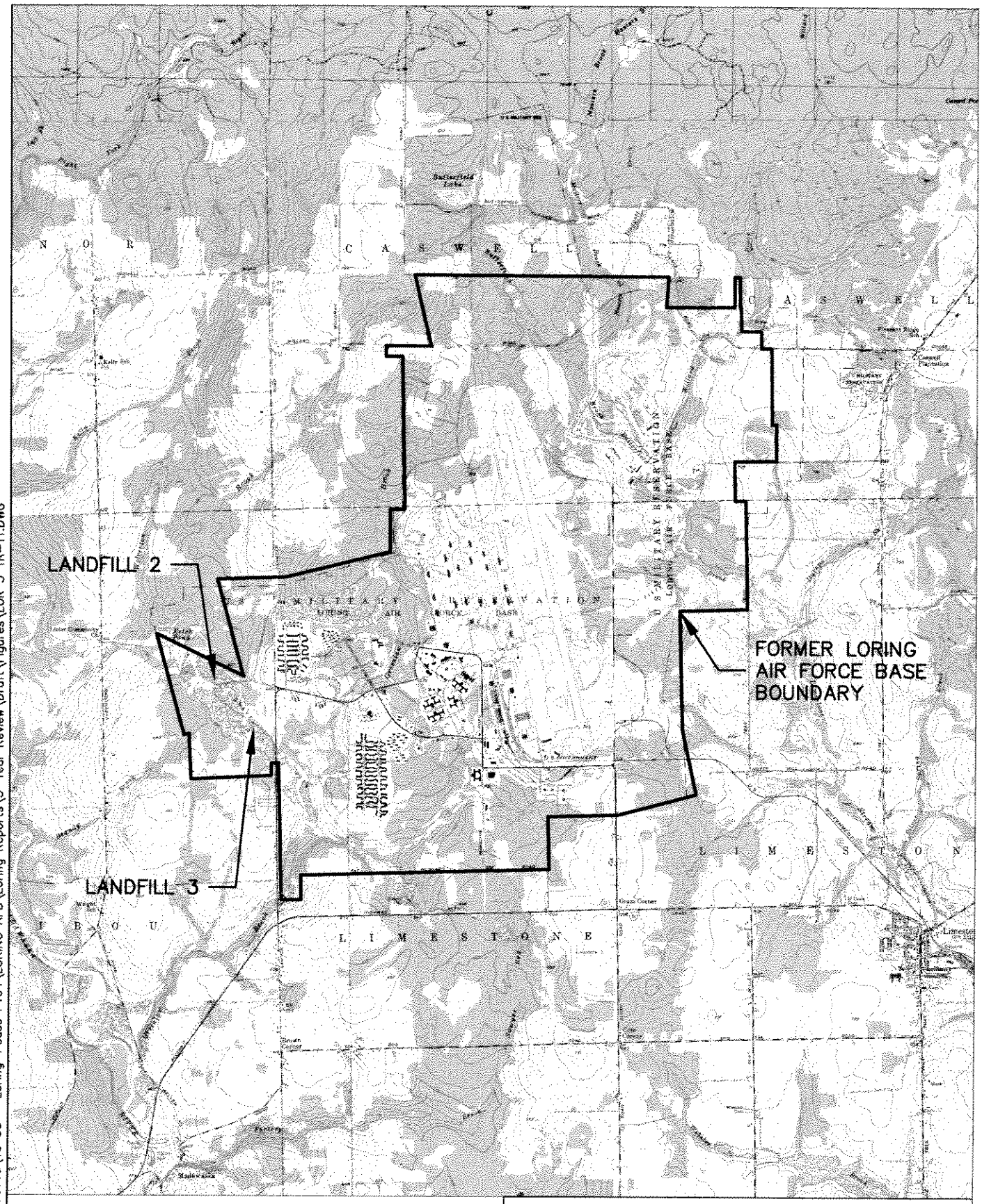
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE, LIMESTONE, MAINE

OPERABLE UNITS, IRP SITES, AND PARCELS

MWH

FIGURE 6.1-1

s:\gis\projects\geomedia projects\loring figures\2005-5YR-REVIEW\OP_PARCELS.GWS 3/31/05



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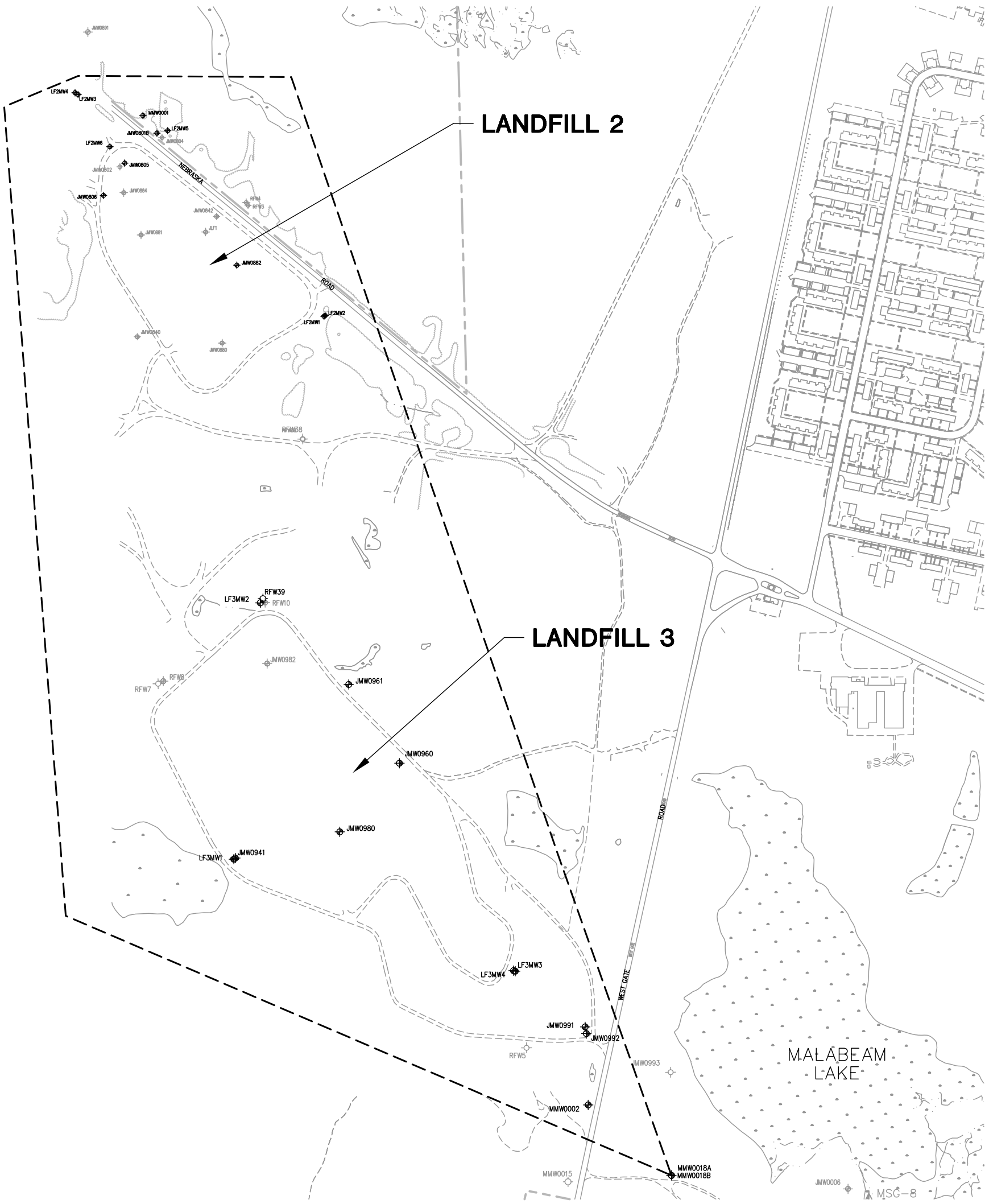
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

LANDFILLS 2 AND 3 SITE LOCATION MAP

MWH

FIGURE 7.3-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-11.DWG



LEGEND

- JMW0882 — LONG TERM MONITORING OVERBURDEN WELL
- MMW0001 — LONG TERM MONITORING BEDROCK WELL
- JLF1 — OTHER OVERBURDEN WELL
- JMW0840 — OTHER BEDROCK WELL
- RFW38 — OTHER OPEN BOREHOLE
- BASE PROPERTY BOUNDARY
- UNPAVED ROAD
- WATER COURSE OR DITCH
- WETLANDS
- COMPLIANCE BOUNDARY

NOTES:

1. COMPLIANCE BOUNDARY WELLS INCLUDE LF2MW3, LF2MW4 AND MMW 0001.
2. JMW0801B REPLACES JMW0801.
3. LF2MW6 REPLACES JMW0802.
4. MONITORING WELL MMW0001 SURVEYED IN MAINE EAST STATE PLANE COORDINATE SYSTEM, NAD83 BY DOODY, BLACKSTONE, AND BUBAR, CARIBOU, MAINE, IN OCTOBER AND NOVEMBER 1999.

north

0 125 250 500

SCALE: FEET
1"=500'

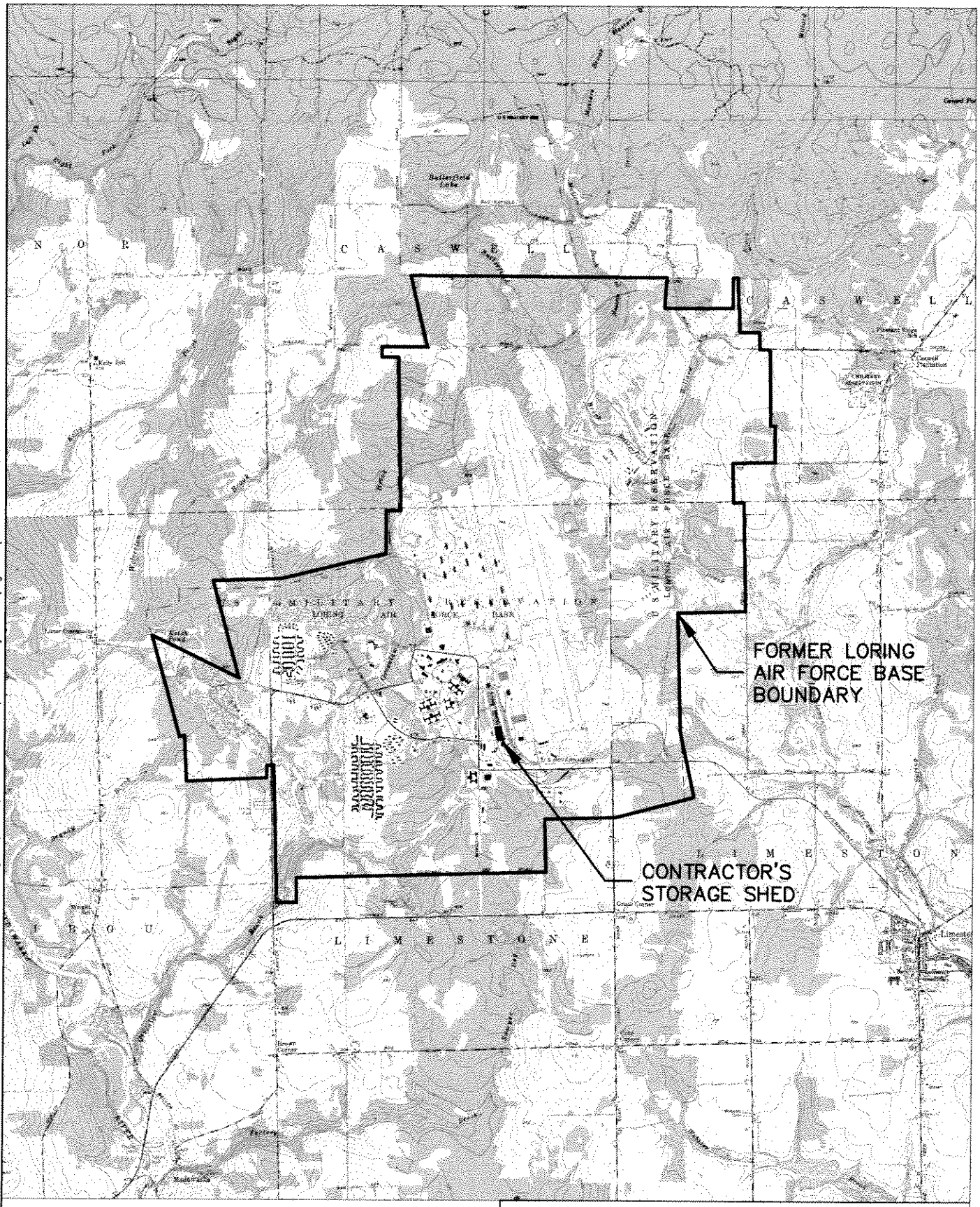
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

LANDFILLS 2 AND 3

MWH

FIGURE 7.3-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-10.DWG



MAINE

0 .25 .5 1
SCALE IN MILES

SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

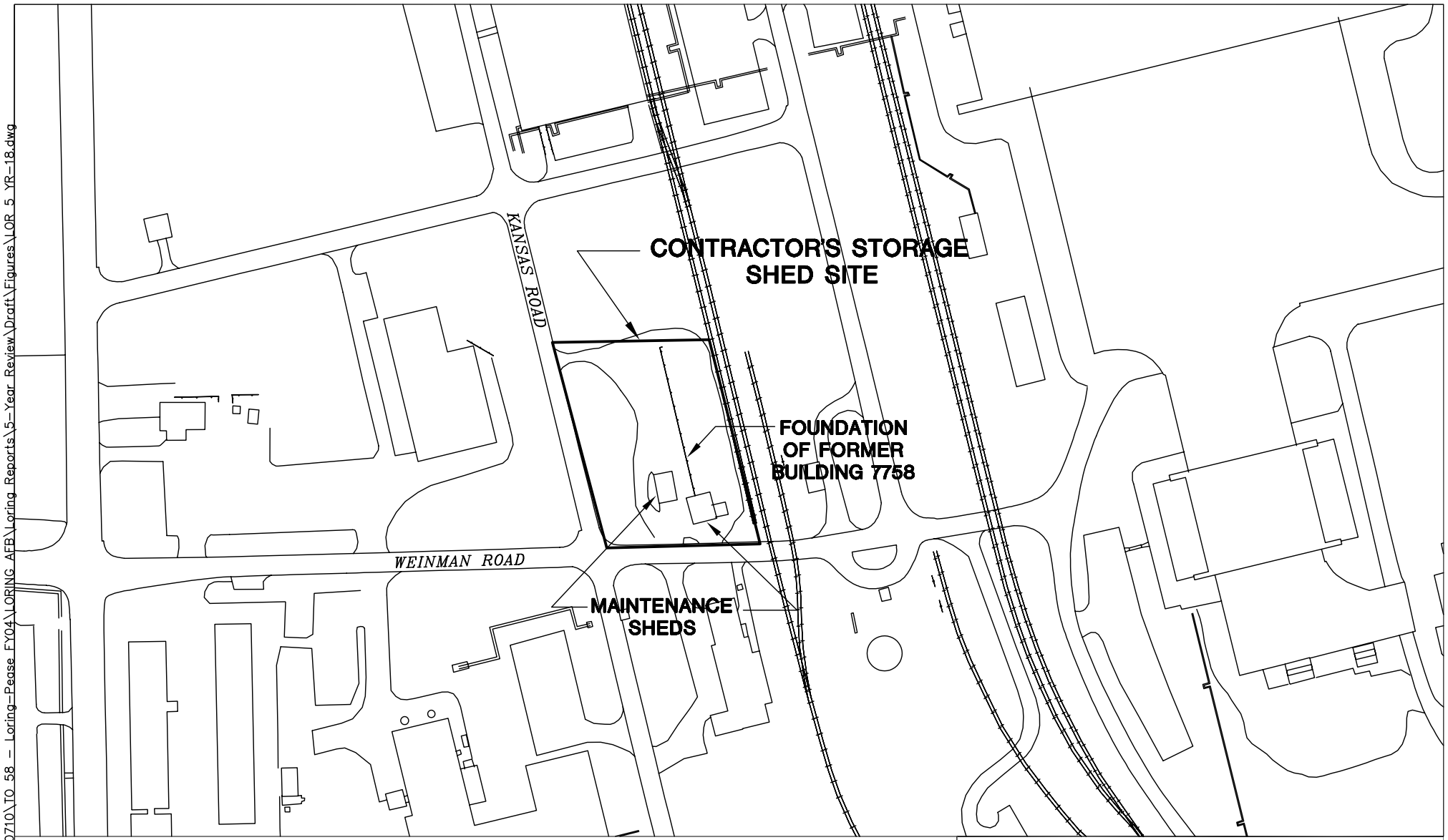
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

CONTRACTOR'S STORAGE SHED SITE LOCATION MAP

MWH

FIGURE 7.4-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Preliminary Draft\Figures\LOR 5 YR-02.DWG



LEGEND

ROAD

RAILROAD

BUILDING

north

0 50 100 200

SCALE: FEET
1"=200'

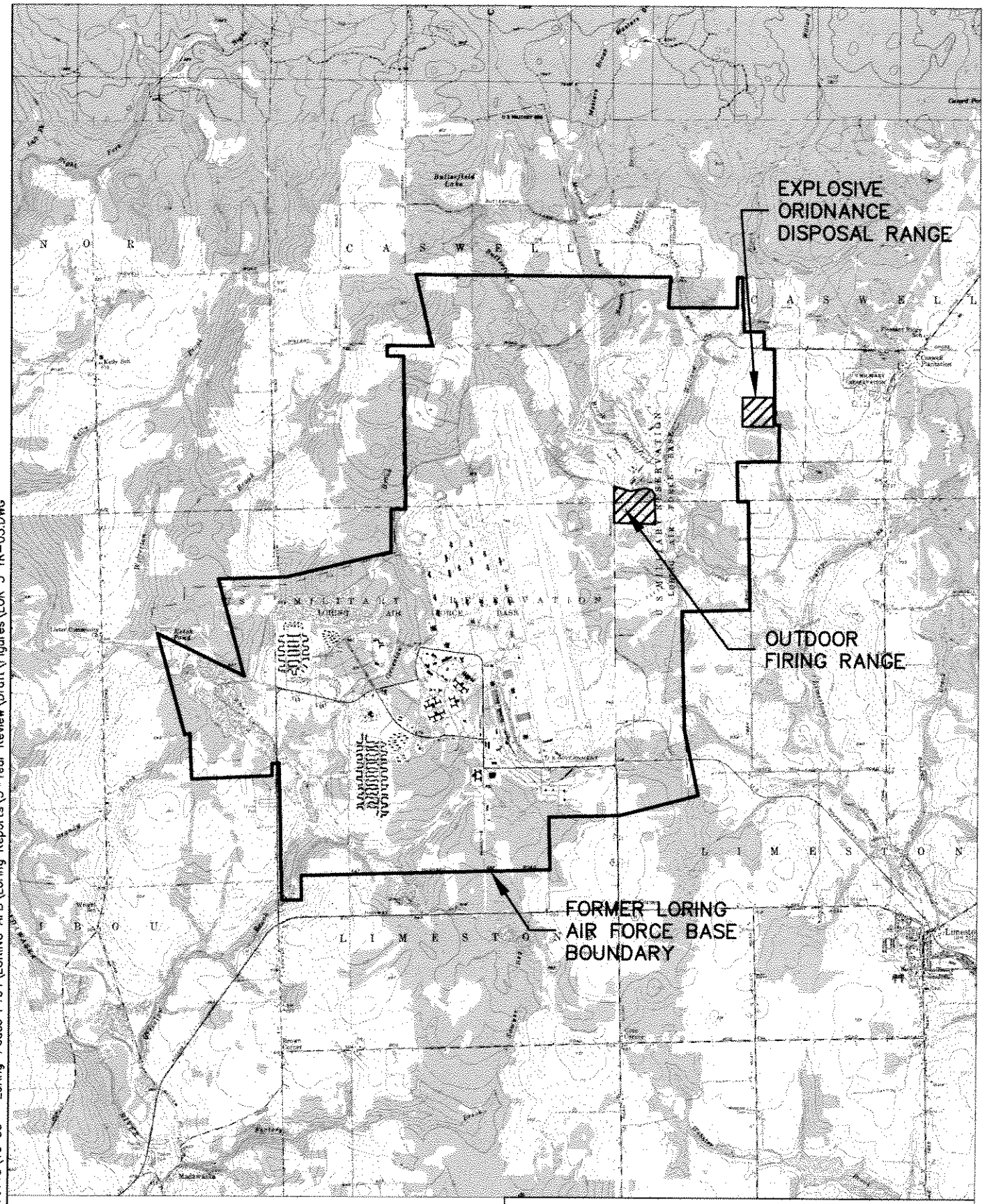
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

SITE PLAN FOR CONTRACTOR'S STORAGE SHED

MWH

FIGURE 7.4-2

S:\FED_PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-18.dwg



MAINE

0 .25 .5 1
SCALE IN MILES

SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

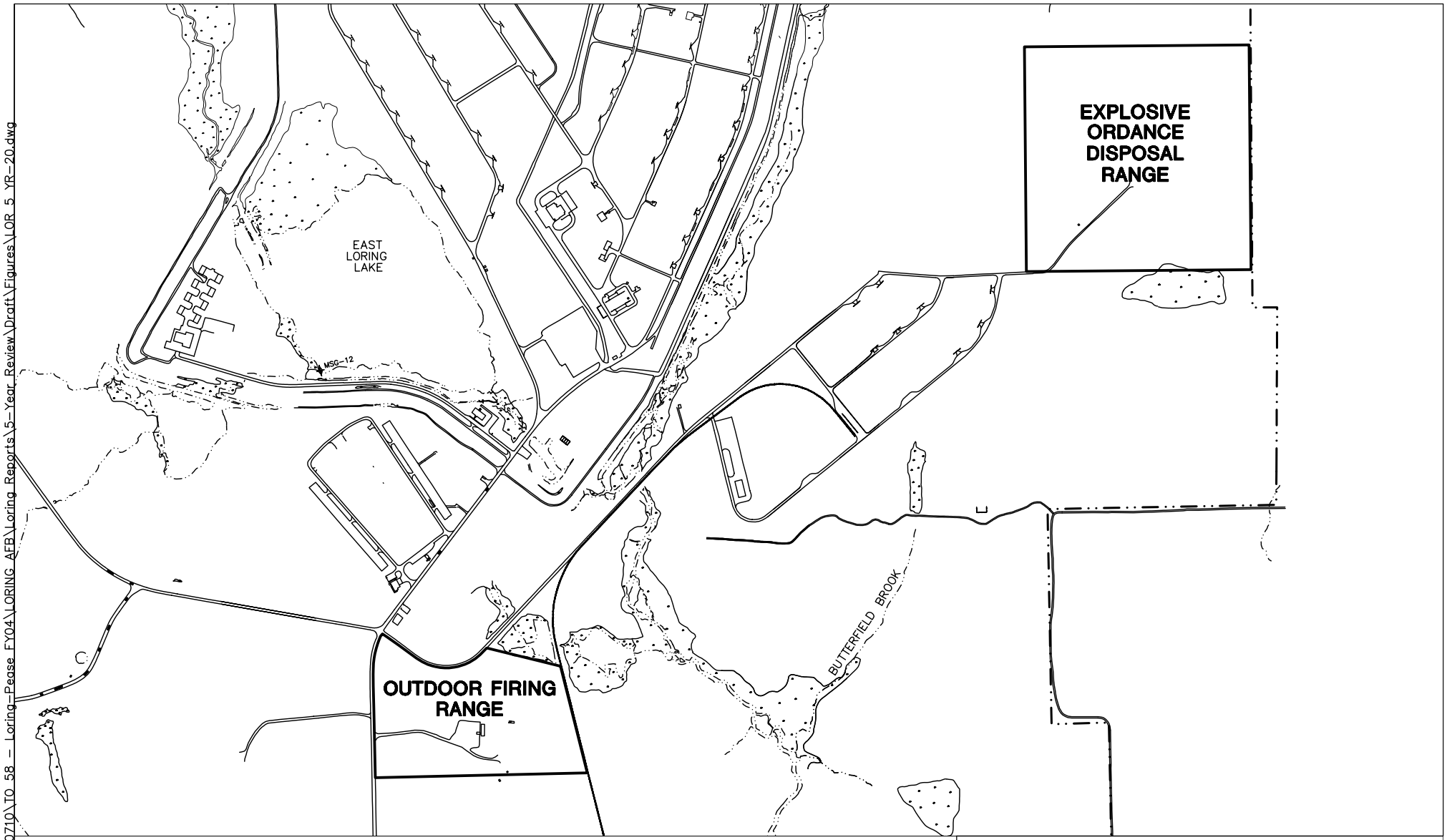
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

EOD RANGE / OFR SITE LOCATION MAP

MWH

FIGURE 7.5-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-03.DWG



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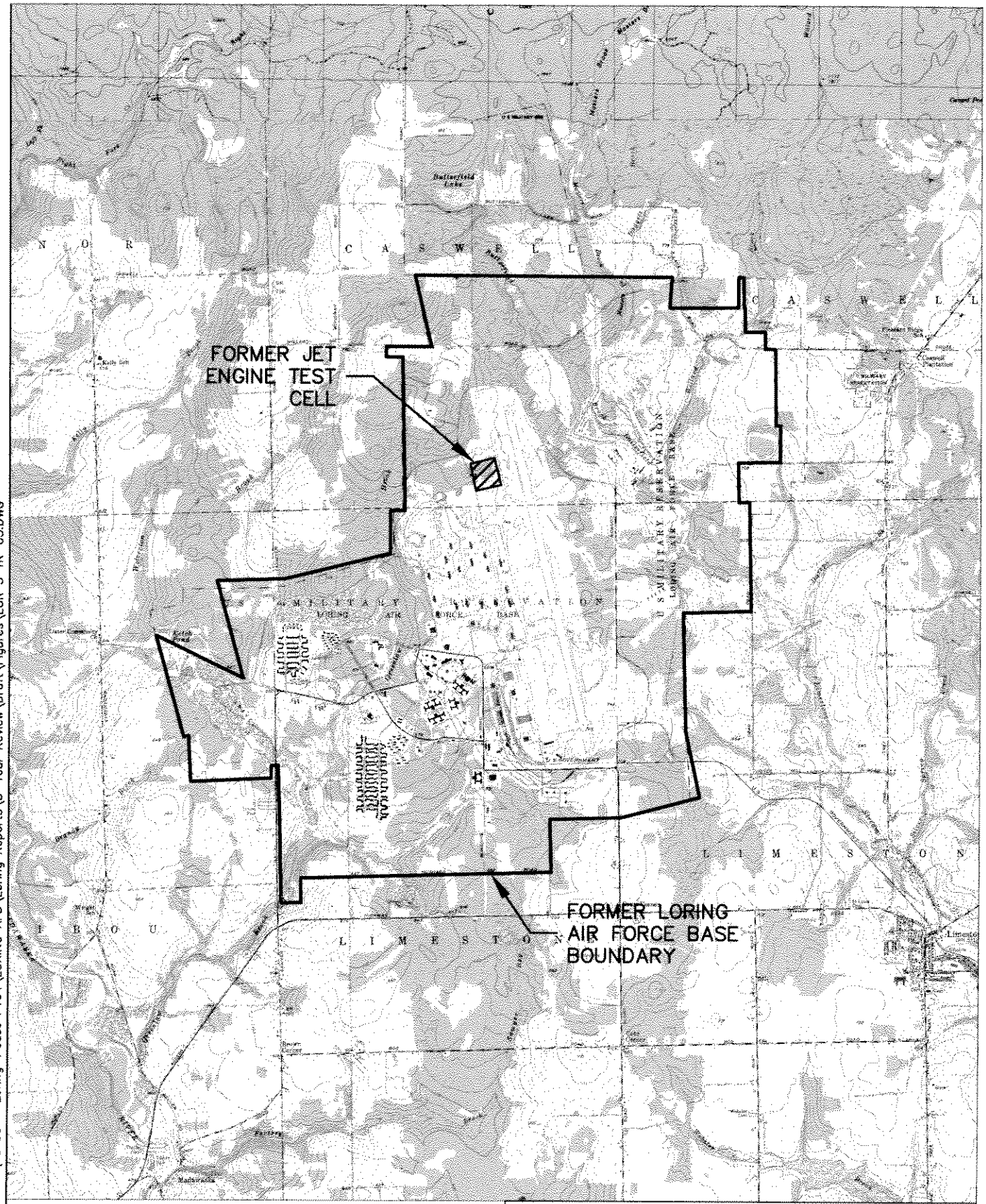
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

SITE PLAN FOR EXPLOSIVE ORDNANCE DISPOSAL RANGE AND OUTDOOR FIRING RANGE

MWH

FIGURE 7.5-2



SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

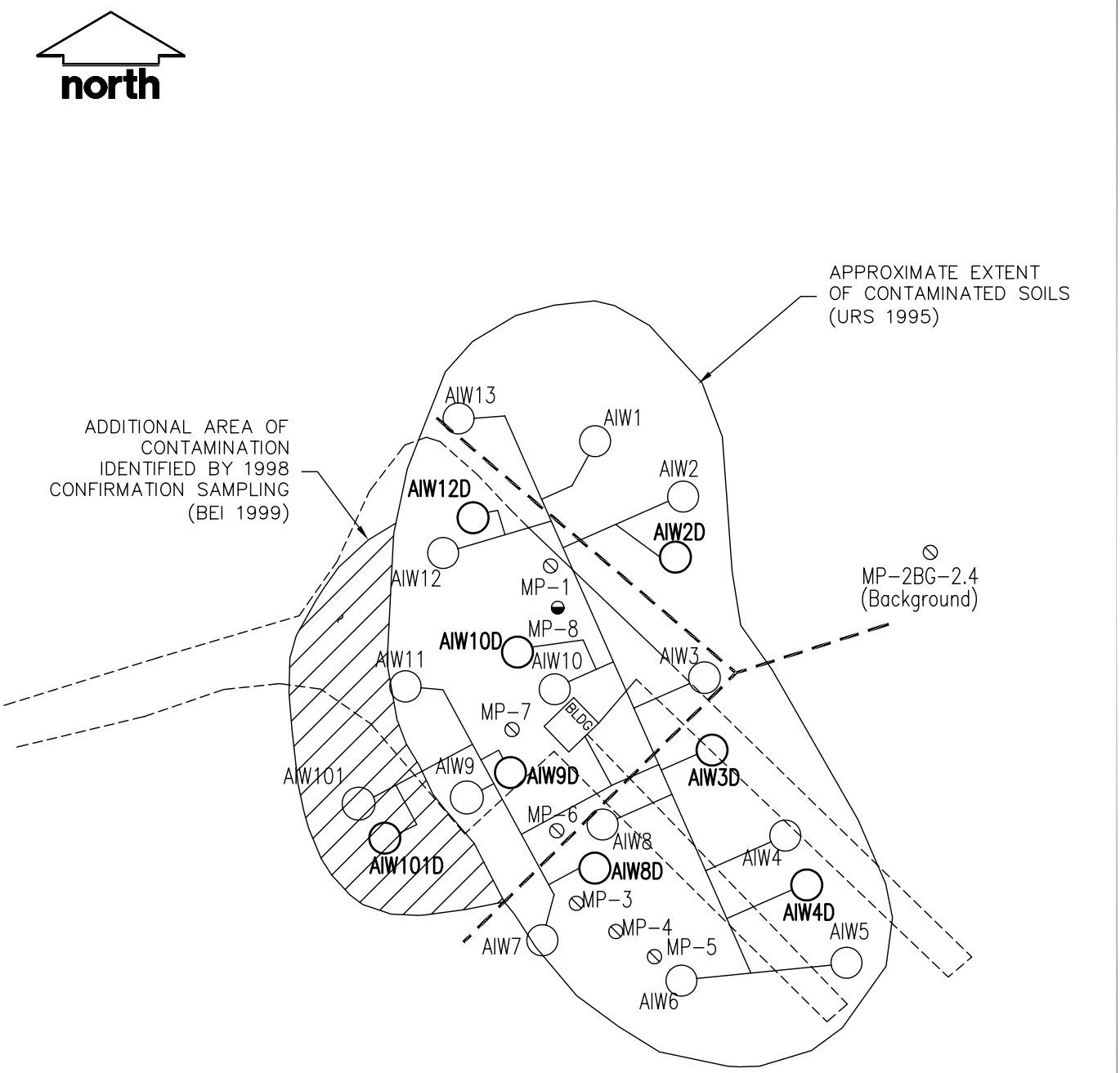
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

FJETC SITE LOCATION MAP

MWH

FIGURE 8.3-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-05.DWG



LEGEND

- AIR INJECTION WELL (= TOTAL FLOW DELIVERED/TOTAL DESIGN FLOW
- MONITORING POINT (W/ O_2 SENSOR)
- MONITORING POINT (W/O O_2 SENSOR)
- BLDG — SUPPORT BLDG AND HOSE CONNECTIONS
- EXTENT OF CONTAMINATION (URS 1995)
- EXTENT OF CONTAMINATION (BEI 1999)
- SUBSURFACE DRAINAGE TRENCH

0 12.5 25 50
SCALE: FEET
1"=50'

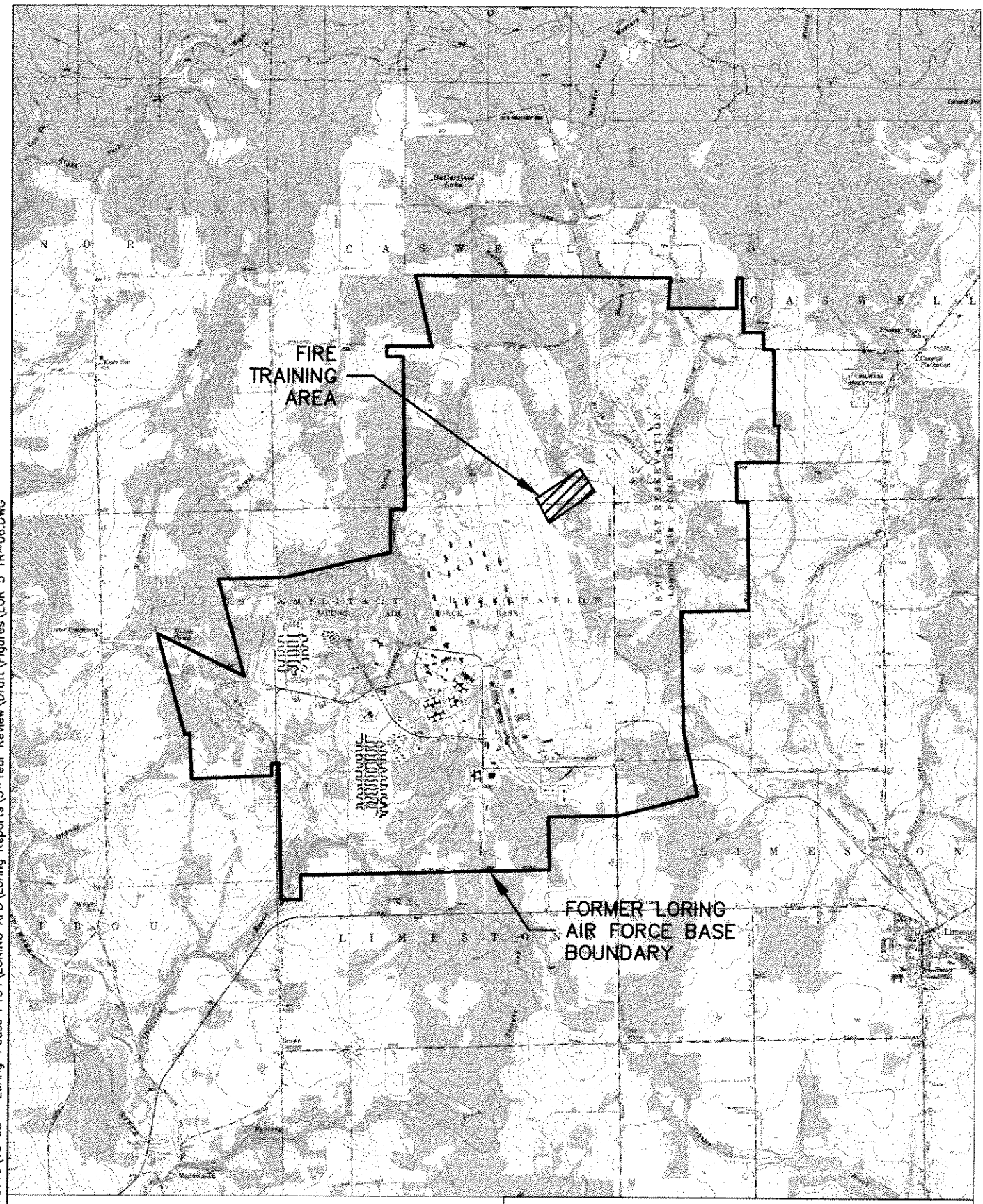
FIVE-YEAR REVIEW REPORT
LORING AIR FORCE BASE
LIMESTONE, MAINE

FJETC SITE MAP

MWH

FIGURE 8.3-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-13.DWG



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MAINE

0 .25 .5 1
SCALE IN MILES

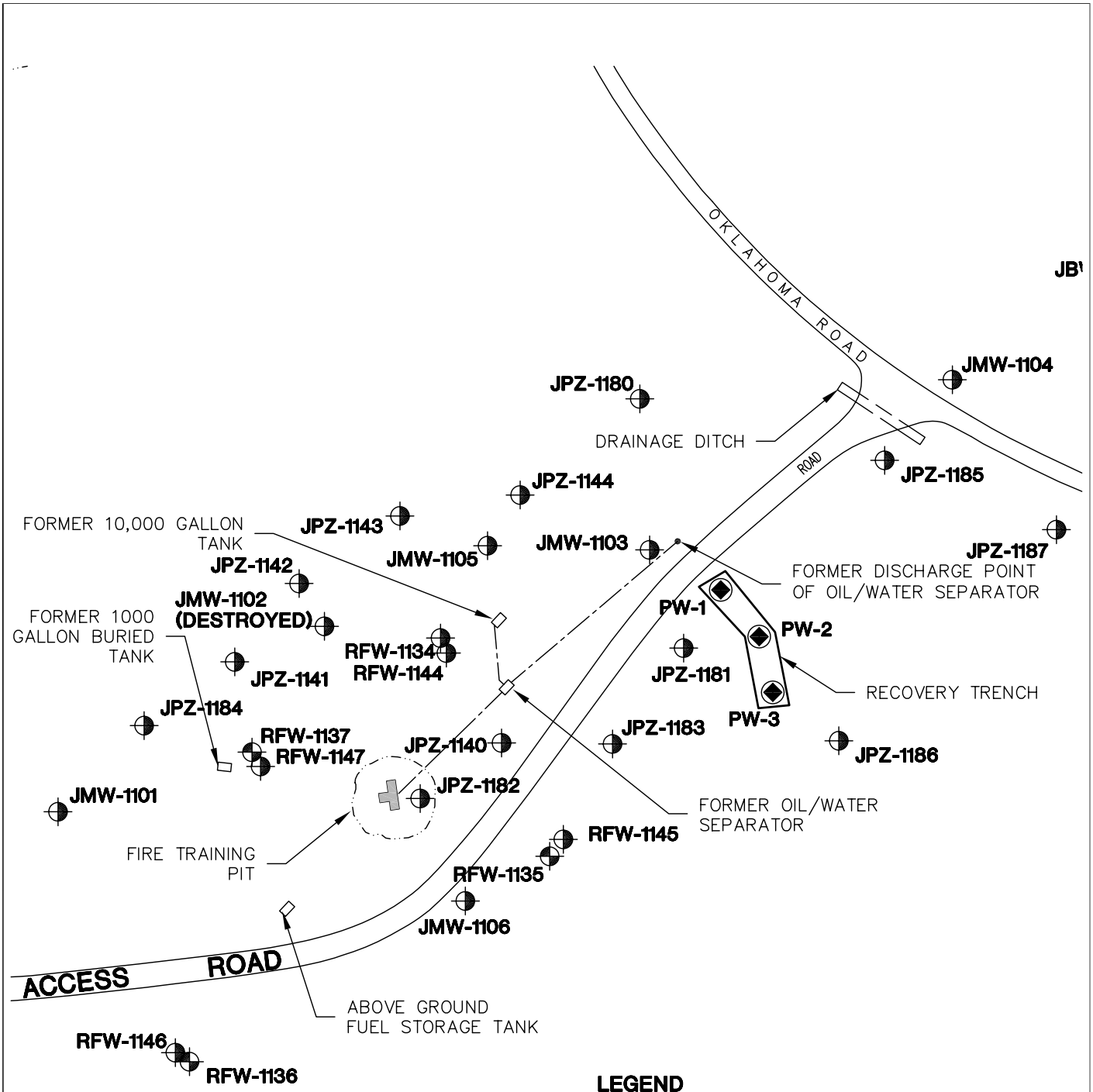
SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

FTA SITE LOCATION MAP

MWH

FIGURE 8.4-1



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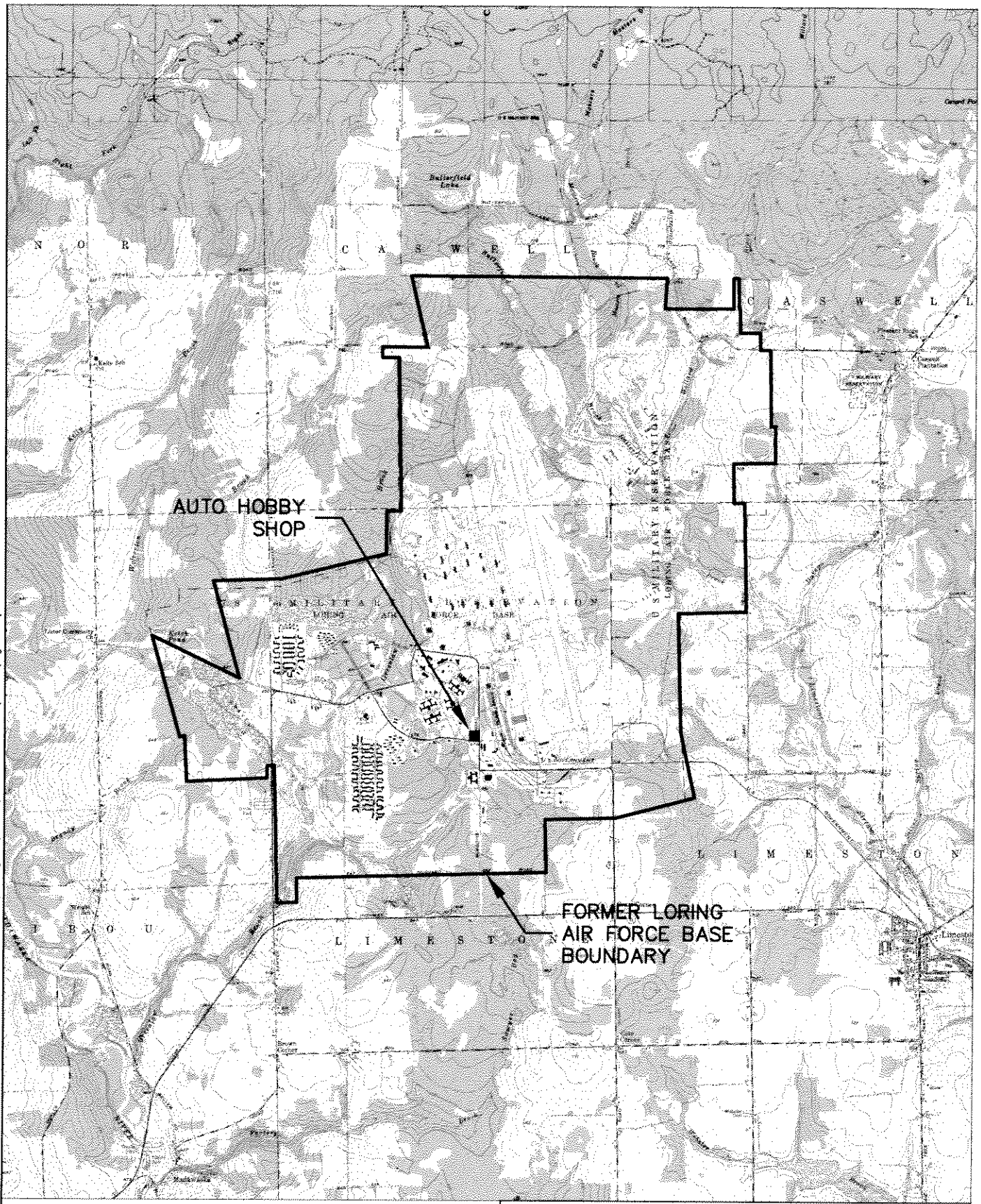
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

FTA SITE PLAN

MWH

FIGURE 8.4-2



SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

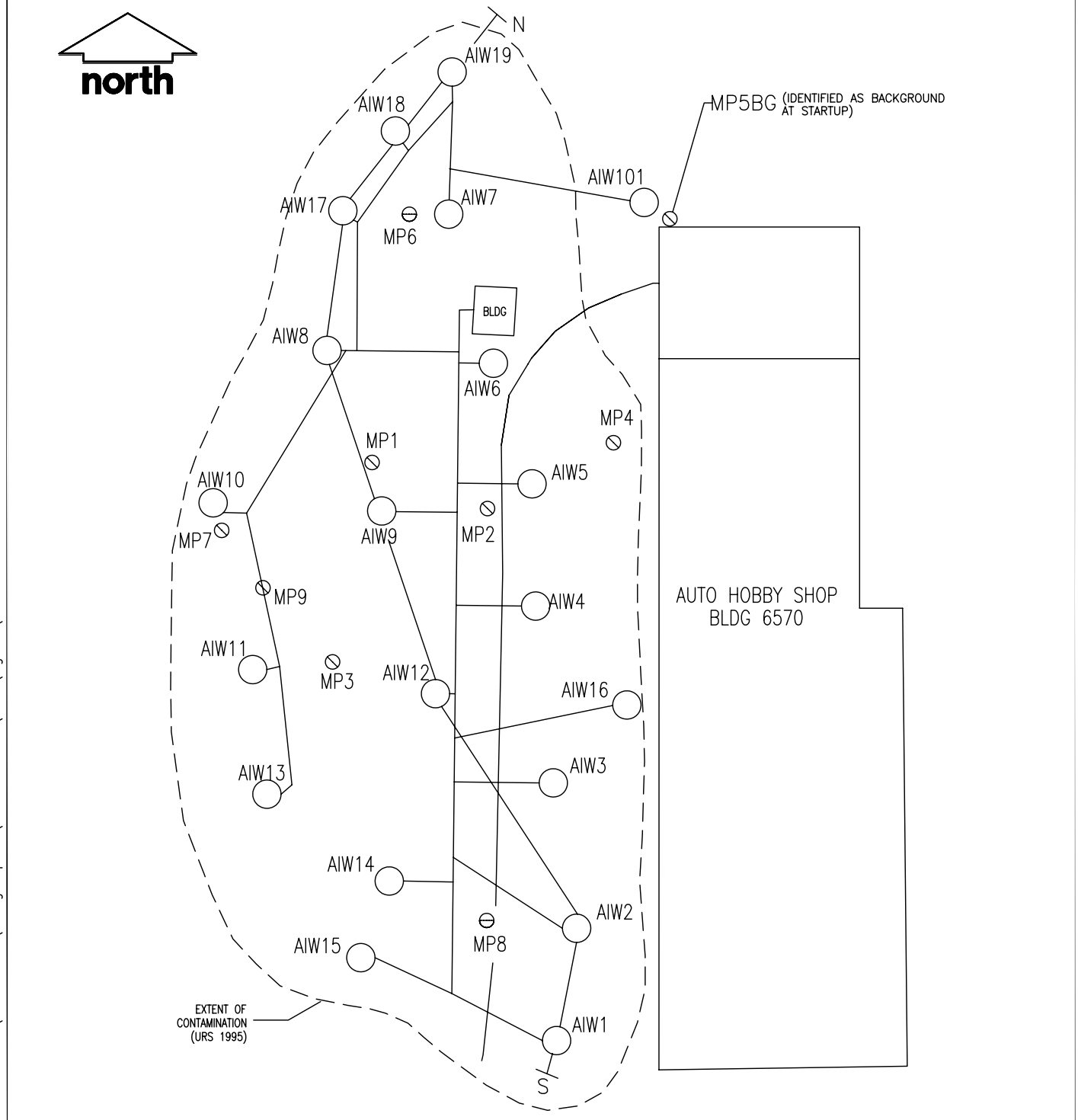
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

AHS SITE LOCATION MAP

MWH

FIGURE 8.5-1

S:\FED PROJECTS\AFCEE-137010\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-07.DWG



LEGEND

- N — S: GROUNDWATER LEVEL CROSS SECTION
- AIR INJECTION WELL
- MONITORING POINT (W/O O_2 SENSOR)
- MONITORING POINT (W/ O_2 SENSOR)
- BLDG: SUPPORT BLDG AND HOSE CONNECTIONS

0 10 20 40
SCALE: FEET

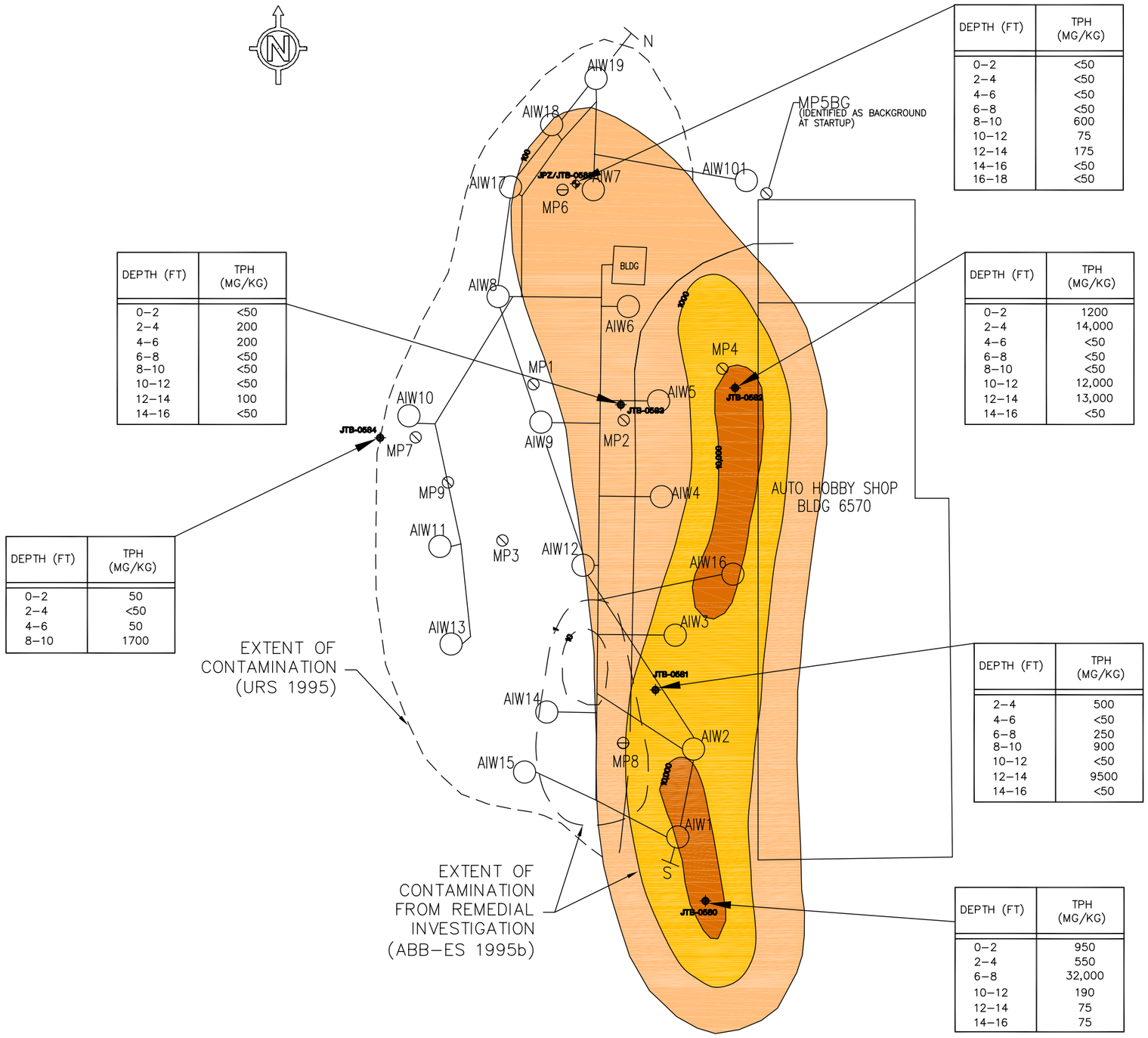
FIVE-YEAR REVIEW REPORT
LORING AIR FORCE BASE
LIMESTONE, MAINE

AHS SITE MAP

MWH

FIGURE 8.5-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-14.DWG



DEPTH (FT)	TPH (MG/KG)
0–2	<50
2–4	<50
4–6	<50
6–8	<50
8–10	600
10–12	75
12–14	175
14–16	<50
16–18	<50

DEPTH (FT)	TPH (MG/KG)
0–2	<50
2–4	200
4–6	200
6–8	<50
8–10	<50
10–12	<50
12–14	100
14–16	<50

DEPTH (FT)	TPH (MG/KG)
0–2	1200
2–4	14,000
4–6	<50
6–8	<50
8–10	<50
10–12	12,000
12–14	13,000
14–16	<50

DEPTH (FT)	TPH (MG/KG)
0–2	50
2–4	<50
4–6	50
8–10	1700

DEPTH (FT)	TPH (MG/KG)
2–4	500
4–6	<50
6–8	250
8–10	900
10–12	<50
12–14	9500
14–16	<50

DEPTH (FT)	TPH (MG/KG)
0–2	950
2–4	550
6–8	32,000
10–12	190
12–14	75
14–16	75

LEGEND

- GROUNDWATER LEVEL CROSS SECTION
- AIR INJECTION WELL
- JTB — HISTORICAL SOIL BORING
- SOIL BORING
- MONITORING POINT (W/O O_2 SENSOR)
- MONITORING POINT (W/ O_2 SENSOR)
- BLDG — SUPPORT BLDG AND HOSE CONNECTIONS
- CONTOURS OF INFRARED (IR) FIELD SCREENING DATA IN SOIL (MG/KG)
- CONTOURS OF TOTAL HYDROCARBON (THC) FROM GC HEADSPACE SCREENING IN SOIL (ppm)
- 100 PPMV TVH
- 1,000 PPMV TVH
- 10,000 PPMV TVH

NOTES:

1. APPROXIMATE DEPTH (FT) OF GROUNDWATER BELOW GROUND SURFACE.

BORING	DEPTH (FT)
JTB–0580	16
JTB–0581	16
JTB–0582	16
JTB–0583	15
JTB–0584	7
JPZ/JTB–0585	10

2. IR AND THC CONTOURS ARE INDICATIVE OF DETECTED LEVELS AT OR ABOVE GROUNDWATER.
3. TPH CONCENTRATIONS ESTIMATED THROUGH INFRARED SPECTROMETRY (IR) ANALYSIS.
4. CONTOURS GENERATED FROM REMEDIAL INVESTIGATION (ABB–ES 1995b).

0 25 50 100
SCALE: FEET
1"=100'

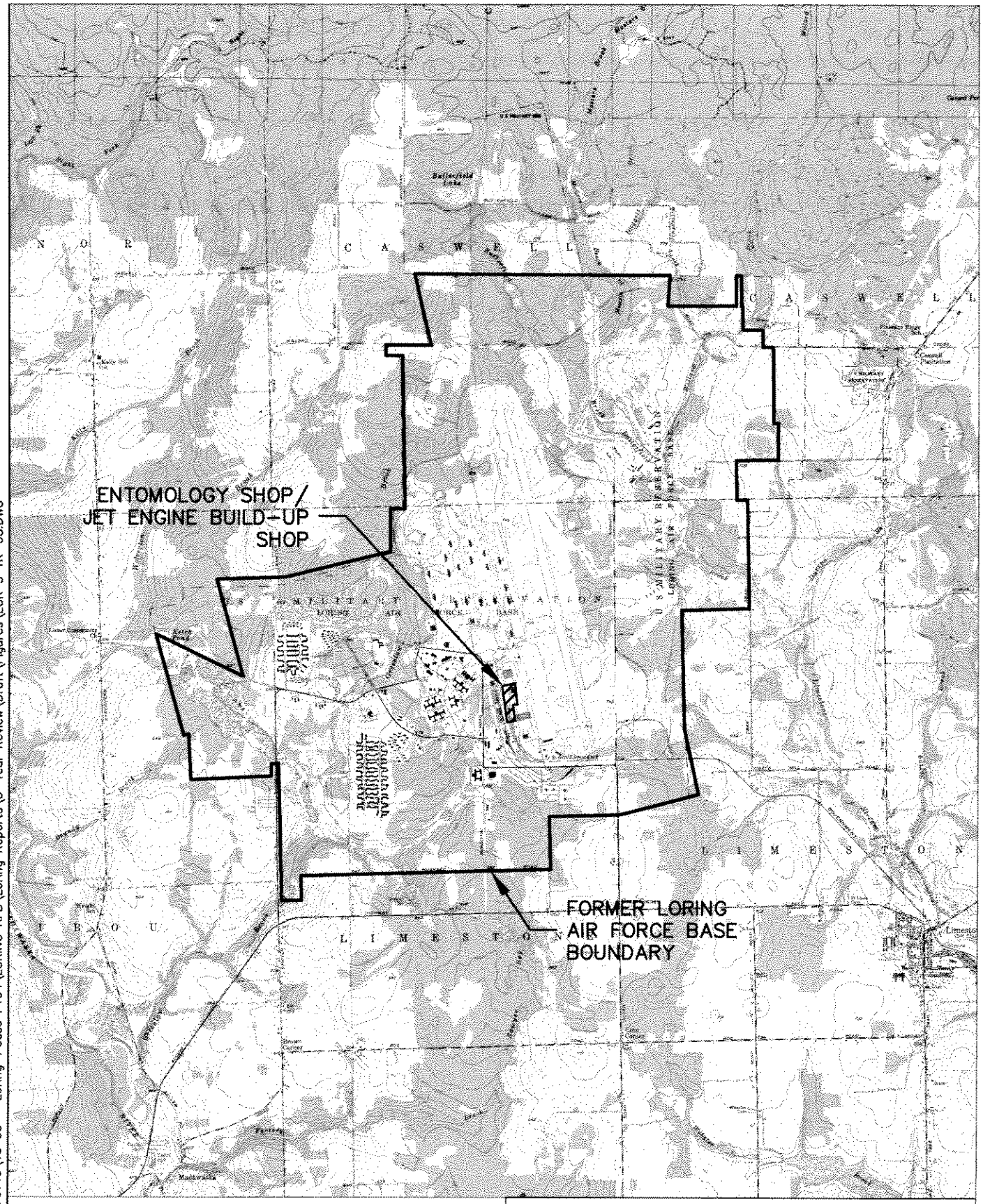
FIVE-YEAR REVIEW REPORT
LORING AIR FORCE BASE
LIMESTONE, MAINE

HISTORICAL EXTENT OF SOIL CONTAMINATION (REMEDIAL INVESTIGATION)

MWH

FIGURE 8.5-3

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-15.DWG



MAINE

0 .25 .5 1
SCALE IN MILES

SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

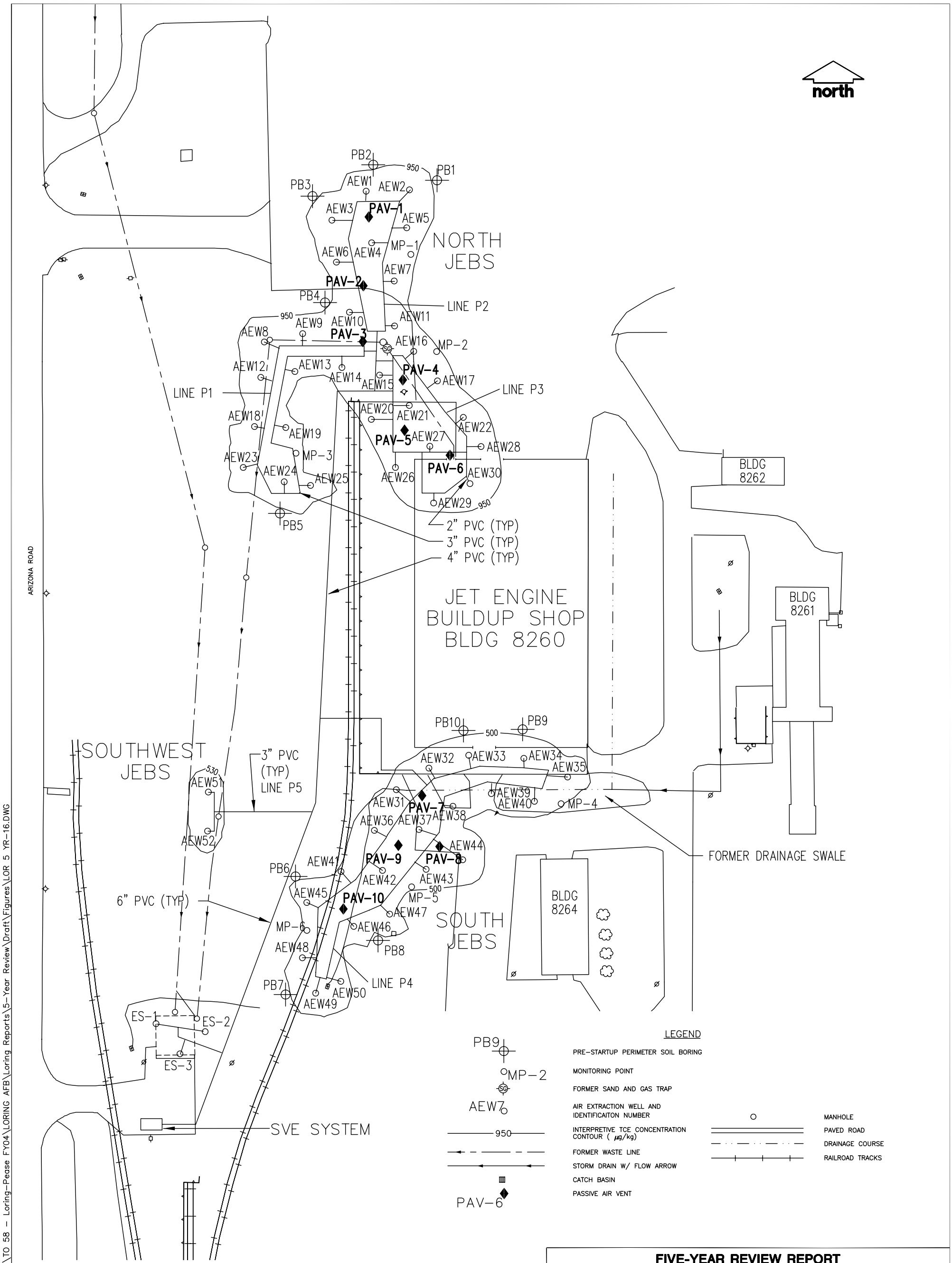
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

ES/JEBS SITE LOCATION MAP

MWH

FIGURE 8.6-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-08.DWG



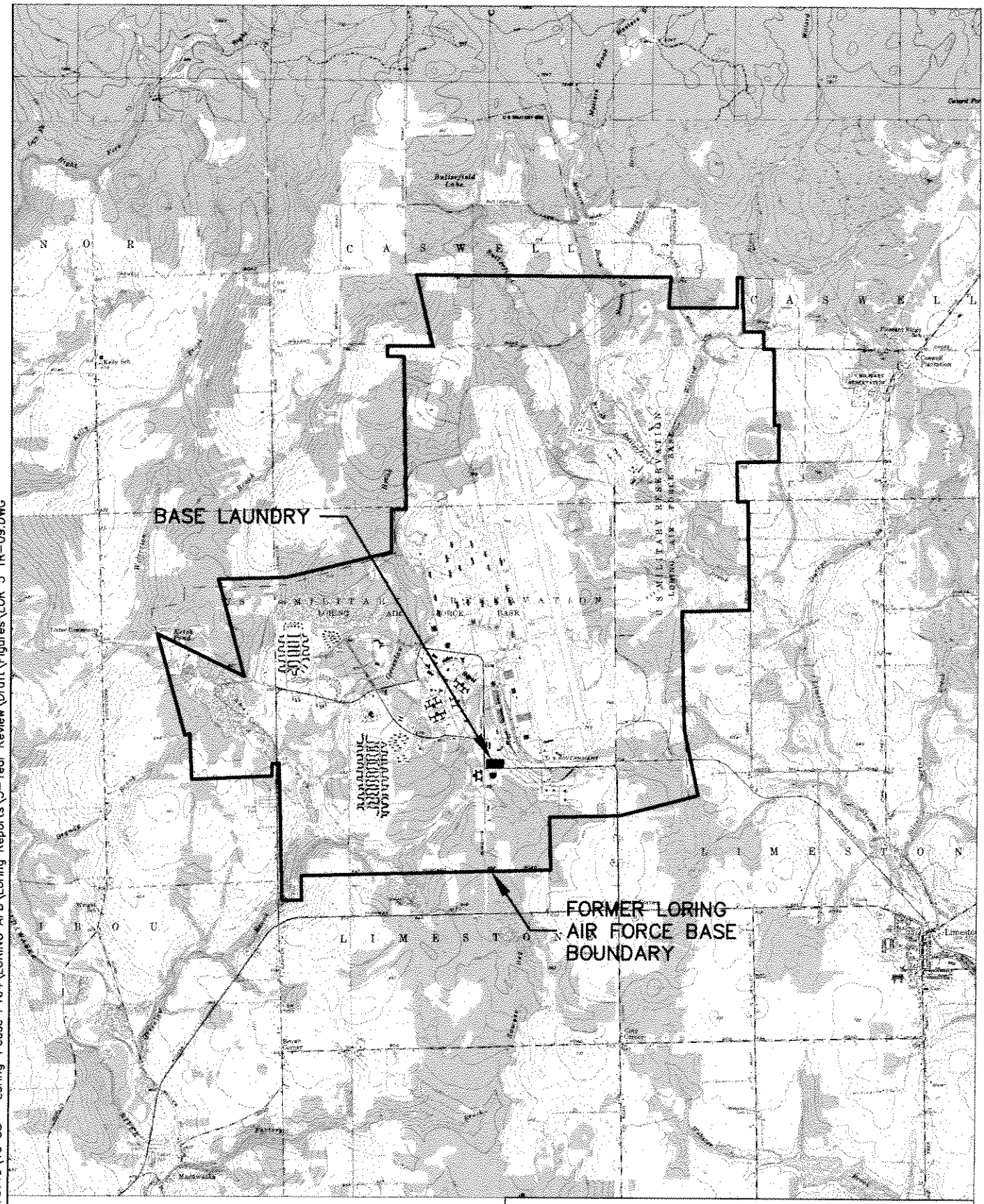
FIVE-YEAR REVIEW REPORT
LORING AIR FORCE BASE
LIMESTONE, MAINE

JEBS SITE MAP

MWH

FIGURE 8.6-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-16.DWG



SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

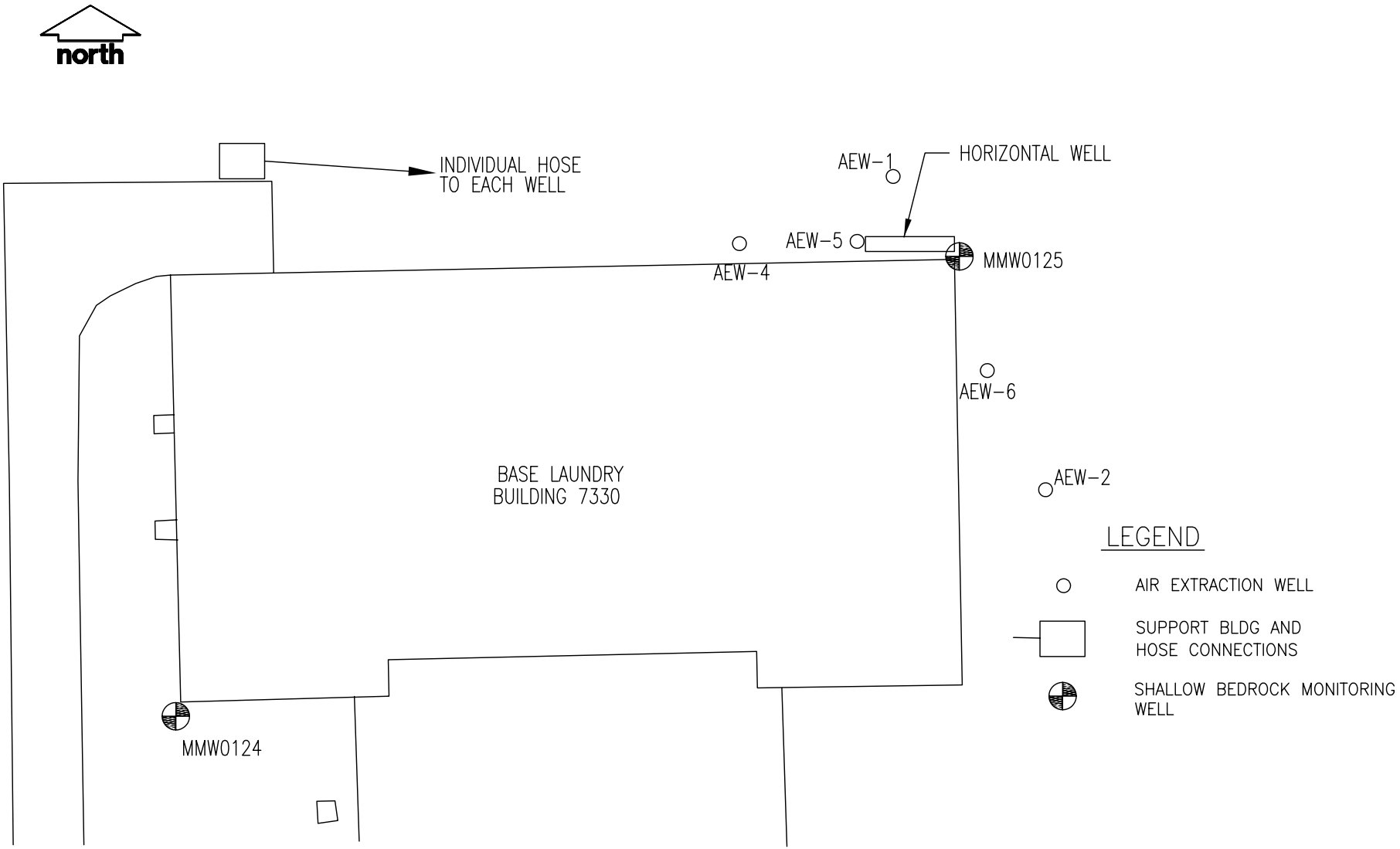
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

BASE LAUNDRY SITE LOCATION MAP

MWH

FIGURE 8.7-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-09.DWG



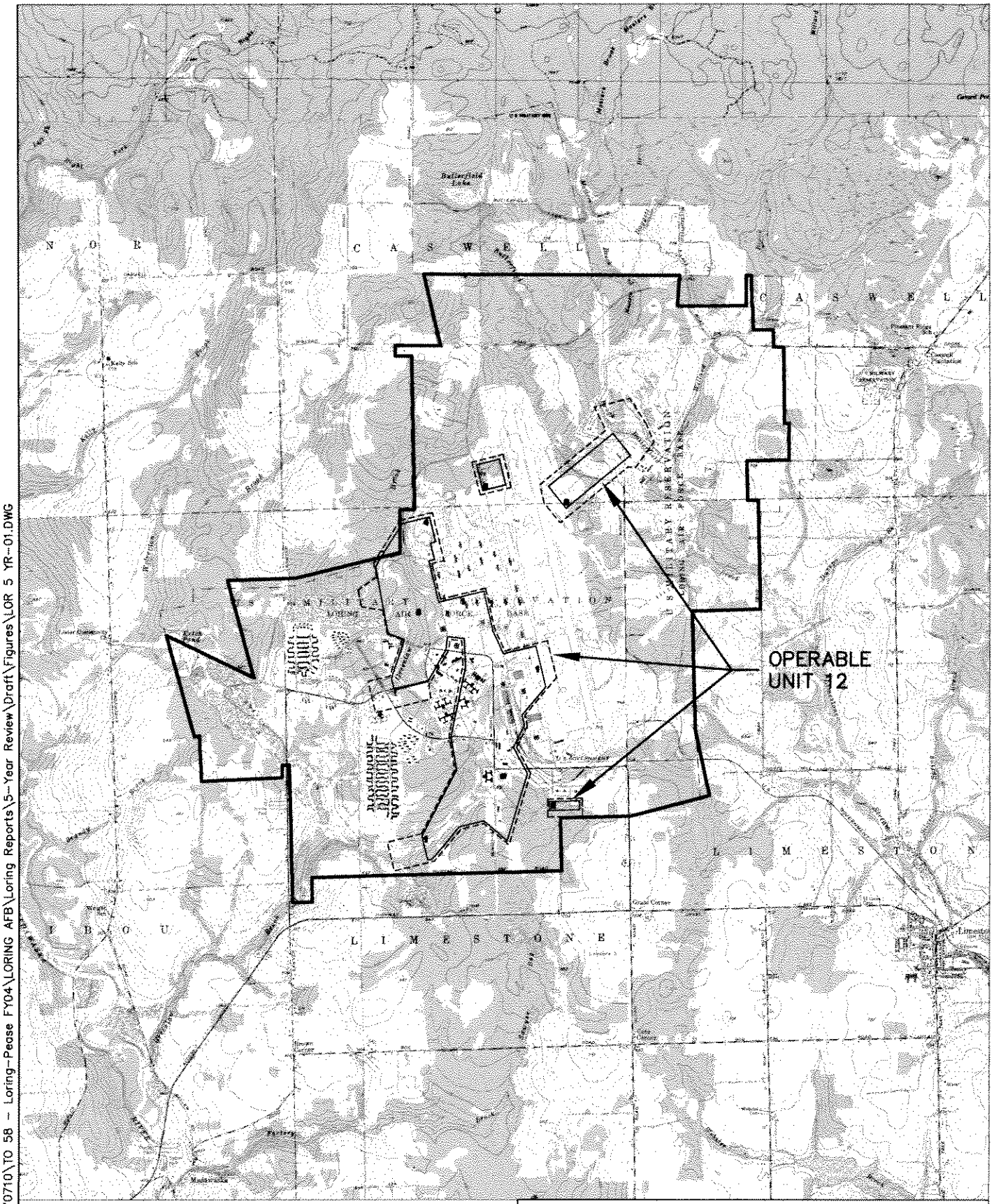
FIVE-YEAR REVIEW REPORT
LORING AIR FORCE BASE
LIMESTONE, MAINE

BASE LAUNDRY SITE MAP

MWH

FIGURE 8.7-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-17.DWG



SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

OU 12 SITE LOCATION MAP

MWH

FIGURE 8.8-1

S:\FED PROJECTS\AFCEE--1370710\TO 58 - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-01.DWG

EAST LORING LAKE

BUTTERFIELD BROOK

MALABEAM LAKE

CHAPMAN PIT

GREEN POND

WEST BRANCH GREENLAW BROOK

EAST BRANCH GREENLAW BROOK

FLDD WETLAND

FLIGHTLINE DRAINAGE DITCH

QUARRY

BLDG 8711

BXSS

UPGRADIENT BXSS

FJETC

FTA

JBW-7734

CENTRAL NDA

JEBS NORTH

FLDD NORTH

ES-JEBS SOUTH

CSS

FLDD SOUTH

VMB

RMSA

BL

PH 8210

FSSB

FTF SOUTH

1

2

3

4

5

6

0 600 1200 1800 ft

- OU 12 LTM OVERBURDEN WELL LOCATION
- OU 12 LTM HYBRID WELL LOCATION
- OU 12 LTM BEDROCK WELL LOCATION
- OU 12 LTM OPEN HOLE BEDROCK WELL LOCATION
- OVERBURDEN WELL ELIMINATED FROM OU 12 LTM PROGRAM
- BEDROCK WELL ELIMINATED FROM OU 12 PROGRAM
- OTHER OVERBURDEN WELL LOCATION
- OTHER HYBRID WELL LOCATION
- OTHER BEDROCK WELL LOCATION
- OTHER OPEN HOLE BEDROCK WELL LOCATION
- BEDROCK EXTRACTION WELL
- ABANDONED WELL LOCATION
- STAFF GAUGE LOCATION
- SURFACE WATER SAMPLE LOCATION
- OVERBURDEN/BEDROCK GROUNDWATER
  ACTION LEVEL EXCEEDENCE LINE
- BTEX/SVOC OVERBURDEN/BEDROCK GROUNDWATER
  ACTION LEVEL EXCEEDENCE LINE
- CHLORINATED SOLVENT OVERBURDEN/BEDROCK
  GROUNDWATER ACTION LEVEL EXCEEDENCE LINE
- AREA REGULATED UNDER MEDEP CMR CHAPTER 691
  RESTRICTED FROM GROUNDWATER USE WITHOUT PERMISSION FROM MEDEP/AF
- GROUNDWATER MANAGEMENT ZONE UNDER CERCLA
  RESTRICTED FROM GROUNDWATER USE WITHOUT PERMISSION FROM EPA/MEDEP/AF
- GROUNDWATER MANAGEMENT ZONE
  COMPLIANCE BOUNDARY
- FORMER LDA AFB PROPERTY BOUNDARY
- PLUME DEFINITIONS
- 1999 LTMP PLUME DEFINITIONS
- AREA NOT REGULATED UNDER CERCLA CONTAINING
  CONCENTRATION OF FUEL ABOVE THE SCREENING VALUE

BASE SOURCE:
FIGURE 4-1, GMZs AND PLUMES, FILE NO. T:\2992-21\2992G10A.DWG, FROM THE FINAL LORING AFB OU-12 LTM PLAN PREPARED BY HAZWRAP, NOVEMBER 1999.

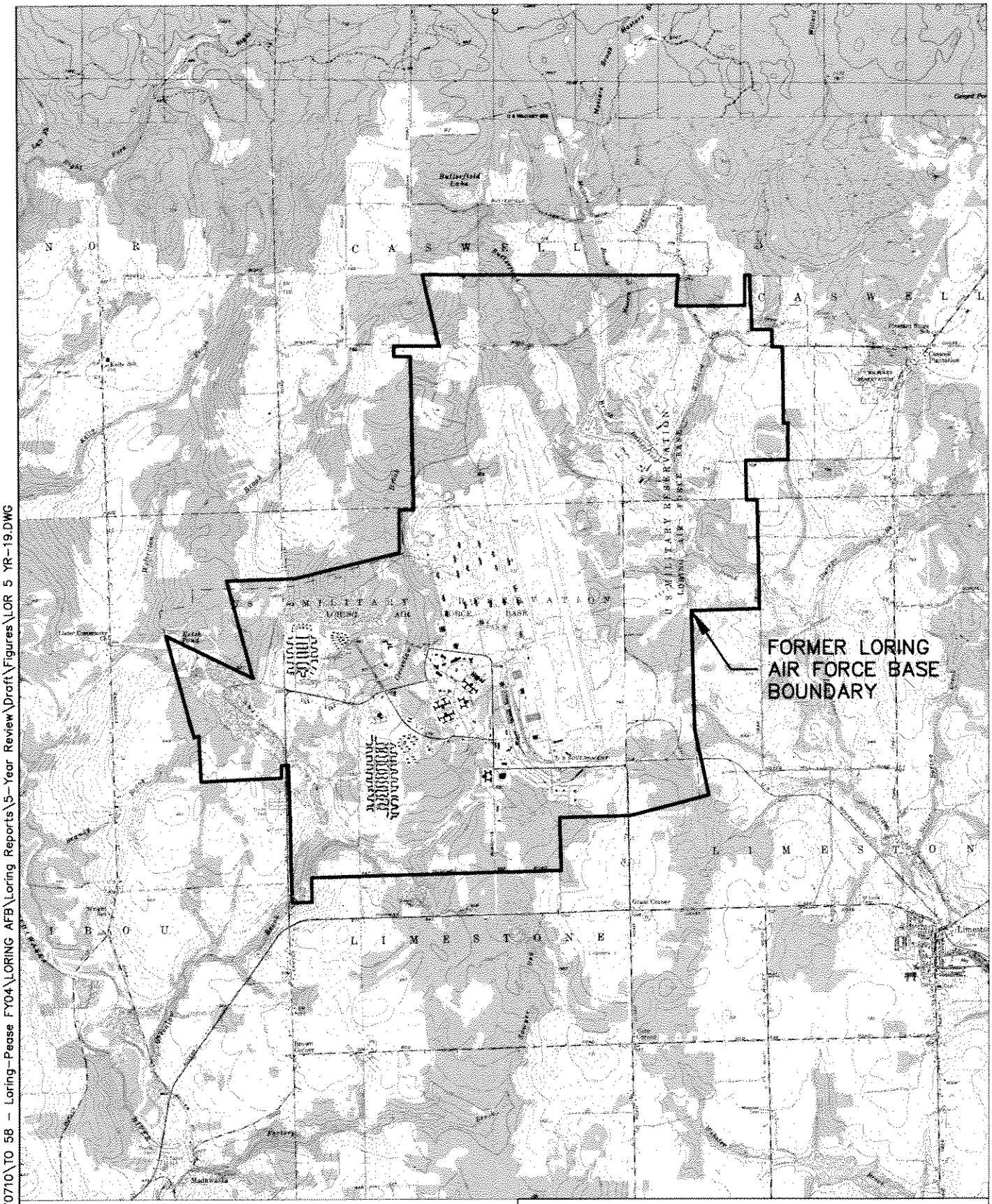
FIVE-YEAR REVIEW REPORT FORMER LORING AIR FORCE BASE, LIMESTONE, MAINE

LOCATION OF GROUNDWATER MANAGEMENT ZONES AND PLUMES

MWH

FIGURE 8.8-2

s:\gis\projects\geomedia projects\loring figures\ 2005-5yr-review\zones_plumes.gws



NOTE:
OU13 INCLUDES SURFACE DRAINAGE FOR ALL OF THE FORMER LORING AIR FORCE BASE.

0 .25 .5 1
SCALE IN MILES

SOURCE:
USGS 1:24,000 TOPOGRAPHIC QUAD SHEETS
LIMESTONE AND FORT FAIRFIELD NW.
(MAPS A LA CARTE, TOPOZONE.COM)

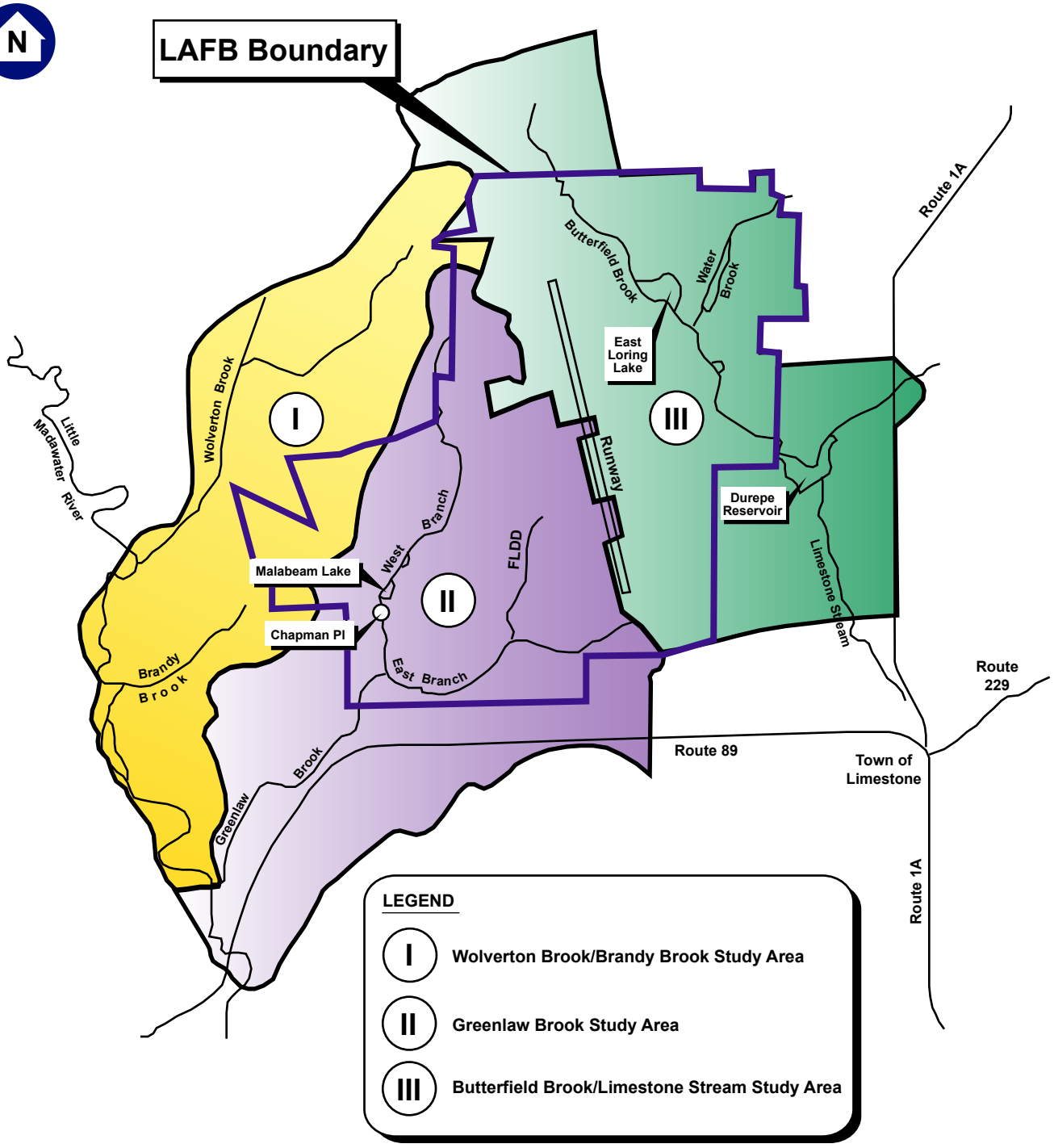
FIVE-YEAR REVIEW REPORT
FORMER LORING AIR FORCE BASE
LIMESTONE, MAINE

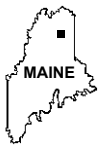
OU13 SITE LOCATION MAP

MWH

FIGURE 8.9-1

S:\FED PROJECTS\AFCEE-1370710\TO 5B - Loring-Pease FY04\LORING AFB\Loring Reports\5-Year Review\Draft\Figures\LOR 5 YR-19.DWG





MAP LOCATION

SCALE IN MILES

0 1 2

Source: ABB Environmental Services, Inc. December 1997, *Operable Unit (OU) 13 Long-Term Monitoring Plan.*

FIVE-YEAR REVIEW REPORT
LORING AIR FORCE BASE
LIMESTONE, MAINE

PRIMARY STUDY AREAS OF OU-13

FIGURE 8.9-2

TABLES

Table 6.2-1

Summary of Five Year Review Report (2000-2005)
Former Loring AFB, Limestone, ME

Site ID	Site Names	Statutory Review	Policy Review	Location in Report
Operable Units 2 & 4	Landfills 2 & 3	X		Section 7.3
Operable Unit 3	Contractors Storage Shed	X		Section 7.4
Operable Unit 3	Explosive Ordnance Disposal Range/Outdoor Firing Range	X		Section 7.5
Operable Unit 5	Former Jet Engine Test Cell		X	Section 8.3
Operable Unit 8	Fire Training Area		X	Section 8.4
Operable Unit 9	Auto Hobby Shop		X	Section 8.5
Operable Unit 10	Entomology Shop/Jet Engine Buildup Shop		X	Section 8.6
Operable Unit 11	Base Laundry		X	Section 8.7
Operable Unit 12	Basewide Groundwater		X	Section 8.8
Operable Unit 13	Basewide Surface Water, Sediment and Fish Tissue		X	Section 8.9

Table 7.3-1

Landfills 2 and 3 Groundwater Action Levels
Five Year Review Report
Former Loring AFB, Limestone, ME

Parameter	Action Levels[(a,b,c)]	Rationale
Landfill 2 Overburden and Bedrock COCs		
Bis(2-ethylhexyl)phthalate	10	PQL
Tetrachloroethene	3	MEG
Vinyl chloride	0.15	MEG
Cadmium	5	MCL
Iron	8,400	Risk-Based
Lead	80	Risk-Based
Zinc	8,400	Risk-Based
Landfill 3 Bedrock COCs		
Vinyl chloride	0.15	MEG
Iron	8,400	Risk-Based
Manganese	1,300	Risk-Based
Landfill 3 Overburden COCs		
1,4-dichlorobenzene	27	MEG
4-methylphenol	140	Risk-Based
Benzene	5	MCL
Tetrachloroethene	3	MEG
Trichloroethene	5	MCL
Vinyl chloride	0.15	MEG
Iron	8,400	Risk-Based
Manganese	1,300	Risk-Based

Notes
(a) Units in micrograms per liter.
(b) Developed by comparison of maximum detected concentration to PQL, background concentration, MCL, and risk-based concentration. MCL takes precedence (ABB-ES, 1996).
(c) Action Levels documented in OU4 Record of Decision (ABB-ES, 1996)

COC = Contaminant of Concern

MCL = Maximum Contaminant level

MEG = Maximum Exposure Guideline

PQL = Practical Quantation Limit

Table 7.3-2

Comparison of Oral Toxicity Factors
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Compound	Oral Slope Factor $(mg/kg/day)^{-1}$		Impact of Current Value on Risk[b]	Oral Reference Dose (mg/kg/day)		Impact of Current Value on Risk[b]
	Value Used in Risk Assessment	Current Value[a]		Value Used in Risk Assessment	Current Value[a]	
Acetone	ND	ND	ND	1.0E-01	9.0E-01	Lower (9)
Aroclor 1254	7.7E+00	2.0E+00	Lower (4)	NC	NC	NC
Aroclor 1260	7.7E+00	2.0E+00	Lower (4)	2.0E-05	ND	Lower
Benzene	2.9E-02	5.5E-02	Higher(2)	3.0E-04	4.0E-03	Lower (10)
Benzo(a)anthracene*	7.3E+0	7.3E-01	Lower (10)	ND	ND	ND
Benzo(b)fluoranthene*	7.3E+0	7.3E-01	Lower (10)	ND	ND	ND
Beryllium	NC	NC	NC	5.0E-03	2.0E-03	Higher (2)
Chlordane (Alpha and Gamma)	1.3E+00	3.5E-01	Lower (4)	6.0E-05	5.0E-04	Higher (10)
Copper	ND	ND	ND	3.7E-02	4.0E-02[c]	Lower(<2)
Chrysene*	7.3E+0	7.3E-03	Lower (1000)	ND	ND	ND
1,2-dibromomethane	8.5E+01	2.0E+00	Lower (40)	ND	9.0E-03	Higher
1,1-Dichloroethene	NC	NC	NC	9.0E-03	5.0E-02	Lower (5)
Indeno(1,2,3-cd)pyrene*	7.3E+0	7.3E-01	Lower (10)	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	4.0E-02	4.0E-03	Higher (10)
Naphthalene	ND	ND	ND	4.0E-02	2.0E-02	Higher (2)
N-nitrosodiphenylamine	NC	NC	NC	ND	2.0E-02[d]	Higher
Phenol	ND	ND	ND	6.0E-01	3.0E-01	Higher (2)
1,1,2,2-Tetrachloroethane	2.0E-01	2.6E-02	Lower	ND	3.0E-02	Higher
Trichloroethene	1.1E-02	4.0E-01[e]	Higher (40)	6.0E-03	3.0E-04[e]	Higher (20)
1,1,1-Trichloroethane	NA	NA	NA	9.0E-02	2.0E-01[d]	Lower (2)
Vinyl Chloride	1.9E+00	1.4E+00	Lower (2)	ND	3.0E-03	Higher
Xylenes	ND	ND	ND	2.0E+00	2.0E-01	Higher (10)

Notes: * These values were used only for the OUs listed.
a: Source is USEPA's Integrated Risk Information System (IRIS), unless otherwise mentioned
b: Indicates whether estimated risks will be lower or higher if values currently available were used. Value in parenthesis indicates the factor (sometimes approximate value) by which risks will differ.
c: Health Effects Assessment Summary Tables (HEAST).
d: Provisional Toxicity Value, EPA
e: EPA (2001). IRIS has withdrawn the slope factor for trichloroethene. The value listed is a provisional value.

mg/kg = milligrams per kilogram
ND: No data available or non-carcinogenic
NC: No Change

Table 7.4-1

Soil Remediation Goals
Operable Unit 3 Contractor's Storage Shed
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Compound	Remediation Goals (1E+06/1E+05)[a, b] (mg/kg)
Total Metals	
Barium	100/1,000[a]
Cadmium	16/160[a]
Lead	880/8,800[a]
Manganese	1,400
Semi-Volatile Compounds	
Benzo(a)Anthracene	0.470
Benzo(a)pyrene	0.400
Benzo(a)fluoranthene	1.100
Benzo(k)fluoranthene	0.400
Chrysene	3/30[a]
Dibenz(a,h)antracene	0.400
Ideao(1,2,3-cd)pyrene	0.400
Pyrene	71/710[a]
Pesticides	
Chlordane	0.07/0.7[a]
4,4'-DDD	0.5/4[a]
4,4'-DDE	0.3/3[a]
4,4'-DDT	0.9/3[a]
Aroclor-1260	1

a - Represents Target Carcinogenic risk of 1 in 1 million/ 1 in 100,000

b - Remediation Goals (RGs) documented in the OU3 Debris Disposal Area Record of Decision (Law, 1996)

Table 8.3-1

Soil Remediation Goals
Operable Unit 5 Former Jet Engine Test Cell
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Chemical of Concern	Remediation Goal[a] (mg/kg)
CERCLA ROD RG (applicable to soils less then 10 ft bgs[b])	
Benzene	1.13
Methylene Chloride	1.17
TCE	5.3
Toluene	26.2
Xylene	21.3
1,2-DCA	0.133
Naphthalene	0.537
TPH	870

[a]Remediation goal (RG) documented in the *Record of Decision for Sites Within Operable Units (OUs) 5, 8, 9, 10, and 11* (HLA, 1999b).
[b] Based on the Sampling and Analysis Flow Diagram (Bechtel, 1999)

Table 8.3-2

Comparison of Inhalation Toxicity Factors
Five-Year Review Report
Former Loring AFB, Limestone, Maine
Page 1 of 1

Compound	Inhalation Slope Factor $(mg/kg/day)^{-1}$		Impact of Current Value on Risk[b]	Inhalation Reference Dose (mg/kg/day)		Impact of Current Value on Risk[b]
	Value Used in Risk Assessment	Current Value[a]		Value Used in Risk Assessment	Current Value[a]	
Aroclor 1260	ND	3.5E-01	Higher	ND	ND	ND
Aroclor 1242	ND	2.0E+0	Higher	ND	ND	ND
Benzo(a)anthracene	ND	3.08E-01	Higher	ND	ND	ND
Benzo(a)anthracene*	6.1E+0	3.08E-01	Lower (20)	ND	ND	ND
Benzo(a)pyrene	ND	3.08E+0	Higher	ND	ND	ND
Benzo(a)pyrene*	6.1E+0	3.08E+0	Lower (2)	ND	ND	ND
Benzo(b)fluoranthene	ND	3.08E-01	Higher	ND	ND	ND
Benzo(b)fluoranthene*	6.1E+0	3.08E-01	Lower (20)	ND	ND	ND
Chlordane	1.3E+0	3.5E-01	Lower (4)	ND	ND	ND
Chrysene	ND	3.08E-03	Higher	ND	ND	ND
Chrysene*	6.1E+0	3.08E-03	Lower (2000)	ND	ND	ND
Dibenz(a,h)anthracene	ND	3.08E+0	Higher	ND	ND	ND
Dibenz(a,h)anthracene*	6.1E+0	3.08E+0	Lower (2)	ND	ND	ND
1,1-Dichloroethene	1.2E+0	1.75E-01	Lower (8)	ND	5.7E-01	Higher
Dieldrin	ND	1.61E+01	Higher	ND	ND	ND
Ethylbenzene	ND	3.85E-03	Higher	NC	NC	NC
Indeno(1,2,3-cd)pyrene	ND	3.08E-01	Higher	ND	ND	ND
Indeno(1,2,3-cd)pyrene*	6.1E+0	3.08E-01	Lower (20)	ND	ND	ND
Naphthalene	ND	ND	ND	ND	8.6E-04	Higher
Nitrobenzene	ND	ND	ND	ND	5.7E-04	Higher
Tetrachloroethene	NC	NC	NC	ND	1.7E-01	Higher
1,1,1-Trichloroethane	ND	ND	ND	2.9E+0	6.3E-01	Lower (4)
Trichloroethene	6.0E0-03	4.0E-01[c]	Higher (70)	ND	1.1E-02[c]	Higher
Xylene	ND	ND	ND	ND	2.9E-02	Higher

Notes: * Values used for the listed OUs only
a: Source is USEPA's Integrated Risk Information System (IRIS), unless otherwise mentioned
b: Indicates whether estimated risks will be lower or higher if values currently available were used. Value in parenthesis indicates the factor (sometimes approximate value) by which risks will differ.
c: EPA (2001). IRIS has withdrawn toxicity values for trichloroethene. The value listed is a provisional value.

ND = No data available or non-carcinogenic
NC = No Change
OU = Operable Unit

Table 8.5-1

Soil Remediation Goals
Operable Unit 9 Auto Hobby Shop
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Contaminants of Concern	Remedial Goal[a] (mg/kg)
CERCLA-Based RGs (applicable 0-10 ft bgs)	
Benzo(a)anthracene	2.5
Benzo(a)pyrene	0.25
Benzo(b)fluoranthene	2.5
Chrysene	8.5
Indeo(1,2,3-c,d)pyrene	2.5
TPH	870

Notes:
[a] Remediation goal (RG) documented in the *Record of Decision for Sites Within Operable Units (OUs) 5, 8, 9, 10, and 11* (HLA, 1999b).

Table 8.6-1

Soil Remediation Goals
Operable Unit 10 Entomology Shop/Jet Engine Buildup Shop
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Chemical of Concern	Area of Site	Remediation Goal[a] (mg/kg)
PCE	North JEBS	1.35
TCE		0.95
Benzo(a)anthracene	South JEBS	0.17
Benzo(a)pyrene		0.25
Chrysene		0.45
PCE		0.75
TCE		0.5
TCE	Southwest JEBS	0.53
TCE	Entomology Shop	0.45
PCE		2.33

[a] Remediation goal (RG) documented in the *Record of Decision for Sites Within Operable Units (OUs) 5, 8, 9, 10, and 11* (HLA, 1999b).

Table 8.7-1

Soil Remediation Goals
Operable Unit 11 Base Laundry
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Chemical of Concern	Remediation Goal[a] (mg/kg)
PCE	5.64

[a] Remediation goal (RG) documented in the *Record of Decision for Sites Within Operable Units 5, 8, 9, 10, and 11* (HLA, 1999b).

Table 8.8-1

OU 12 Summary Remedial Alternatives and Site Specific Analytes
Five-Year Review Report
Former Loring AFB

Groundwater Monitoring Zone/ Plume	Plume Type	Limited Action Alternative	Analytes to be Monitored	GMZ Alternative	Analytes to be Monitored
GMZ 1					
Central NDA	Mixed			√	PCE, TCE, VC, Ben, Napth, PHC[a]
PH 8210				√	Ben, Xyl, Ethylben, *MeCl, Napth, Fe, Mn, PHC [a]
FSSB	Chlorinated	√	1,1,1-TCA, Pb, Mn		
JEBS North	Mixed			√	TCE, cis-1,2-DCE, VC, Napth, Mn
ES/JEBS South	Mixed			√	TCE, cis-1,2-DCE, VC,Ben, Napth, Pb, Mn, PHC [a]
CSS	Mixed	√	cis-1,2-DCE, 1,2-DCA, VC, MeCl, Xyl, Pb, Mn, PHC[1]		
FLDD North	Mixed			√	TCE, cis-1,2-DCE, VC, 1,1,1-TCA, 1,2-DCA, Ben, Xyl, Tol, Napth, MeCl, Fe, Pb, Mn, Sb, PHC[a]
FLDD South	Mixed			√	TCE, PCE, cis-1,2-DCE, 1,2 DCA, VC, Ben, Xyl, Tol, Napth, Pb, Mn, Sb, PHC [a]
BL	Mixed			√	PCE, TCE, Ben, Mn
VMB	Mixed			√	PCE,TCE, cis-1,2-DCE, 1,2-DCA, VC, Ben, Xyl, Tol, Pb, Mn, PHC [a]
RMSA	Mixed	√	VC, Pb, Mn		
GMZ 2					
FTF South	Chlorinated	√	VC, PCE		
GMZ 3					
Upgradient BXSS	Chlorinated	√	TCE		
Building 8711	Chlorinated	√	TCE, PCE, Aro-1260		
BXSS	Fuel			√	Ben, MTBE, PHC [a]
GMZ 4					
Quarry	Mixed			√	PCE, TCE, cis-1,2-DCE, VC, 1,1-DCE, 1,2-DCA, carbon tet, Ethylben, Napth, Tol, Chloroform, Chlorobenzene, Ben, Mn, PHC [a]

Table 8.8-1

OU 12 Summary Remedial Alternatives and Site Specific Analytes
Five-Year Review Report
Former Loring AFB

Groundwater Monitoring Zone/ Plume	Plume Type	Limited Action Alternative	Analytes to be Monitored	GMZ Alternative	Analytes to be Monitored
GMZ 5					
FJETC	Mixed			√	TCE, cis-1,2-DCE, VC, Ben, Xyl, Napth, PHC [a]
GMZ 6					
FTA	Mixed			√	VC, TCE, PCE, Ben, Xyl, Chlorometh, carbon tet, 4-meth-2-pent, Napth, Cd, Fe, Pb, Mn, PHC [a]
SWP and C-SMPs					
JBW-7734	NA	√	VC		
JPZ-0344	NA	√	1,2-Dibromo-3-chloropropane		
JMW-3082	NA	√	1,2-DCP		
JMW-0401	NA	√	Chrysene, Mn		

Notes:

1,1-DCE=1,1-dichloroethene
1,2-DCA=1,2-dichoroethane
1,1,1-TCA=1,1,1-trichloroethane
1,2-DCP=1,2-dichloropropane
4-meth-2-pent=4-methyl-2-pentanone
Aro-1260=Arochlor 1260
Ben=benzene
carbon tet=carbon tetrachloride
cis-1,2-DCE=cis-1,2-dichloroethene
Chlorometh=chloromethane
Cd=cadmium
Ethylben=ethylbenzene
Fe=Iron
Mn = manganese
MeCl=methylene chloride
MTBE = methyl-tert-butyl-ether
Napth=naphthalene
Pb=lead
PCE=tetrachloroethylene
PHC = petroleum hydrocarbons
Sb=antimony
TCE=trichloroethylene
Tol=toluene
VC=vinyl chloride
Xyl=xlyenes

SWP=Single Well Plume
C-SMP=compound-specific monitoring point
Mixed= a plume consisting of both chlorinated and petroleum-related compounds

NDA= Nose Dock Area
PH = pumphouse
JEBS=Jet Engine Buildup Shop
ES=Enotmology Shop
CSS=Contractors Storage Shed
FLDD=Flightline Drainage Ditch
BL=Base Laundry
VMB= Vehicle Maintainence Building
RMSA=Refueling Maintainence Shop
BXSS=Base Exchange Service Station
FJETC=Former Jet Engine Test Cell
FTA=Fire Training Area
FTF=Fuels Tank Farm

[a] = PHCs may be present at concentrations above the risk-based screening value but will only be monitored at the Compliance Boundary of the GMZ.

*= this compound will only be monitoried at JMW-1565 in this plume.

Table 8.8-2

Groundwater Remediation Goals[a]
OU 12 Long-Term Monitoring Program
Five-Year Review Report
Former Loring AFB, Limestone, Maine

	Contaminated Groundwater Area RGs by Plume											
	GMZ 1											
Chemical of Concern [b]	**CNDA**	**PH 8210**	**FSSB**	**JEBS North**	**ES/JEBS South**	**CSS**	**FLDD North**	**FLDD South**	**BL**	**VMB**	**RMSA**	**Compliance Boundary RGs**
Volatile Organics												
1,1,1-Trichloroethane			**200**				**200**					**200**
1,2-Dichoroethane						**5**	**5**	**5**		**5**		**5**
Benzene	**5**	**5**			**5**		**5**	**5**	**5**	**5**		**5**
cis-1,2-Dichloroethene				**70**	**70**	**70**	**70**	**70**		**70**		**70**
Ethylbenzene		**700**										**700**
Methylene Chloride		**5**				**5**	**5**					**5**
Naphthalene	**480**	**480**		**480**	**480**		**480**	**480**				**25**
Tetrachloroethylene	**5**							**5**	**5**	**5**		**3**
Toluene							**1000**	**1000**		**1000**		**1000**
Trichloroethylene	**5**			**5**	**5**		**5**	**5**	**5**	**5**		**5**
Vinyl Chloride	**2**			**2**	**2**	**2**	**2**	**2**		**2**	**2**	**0.15**
Xylene												**600**
Inorganics												
Antimony							**6**	**6**				**6**
Iron (overburden only)		**2527**					**2527**					**2527**
Lead			**15**		**15**	**15**	**15**	**15**		**15**	**15**	**15**
Manganese		**396**	**396**	**396**	**396**	**396**	**396**	**396**	**396**	**396**	**396**	**200**

NOTES:

[a] Groundwater Remediation Goals (RGs) documented in OU12 Record of Decision (HLA, 1999)

[b] All concentrations are in micrograms per liter (µg/L)

[c] There is no Contaminated Groundwater Area RG for PHCs; however, there is a risk-based screening value (i.e., 361 µg/L) for monitoring PHCs at the GMZ Compliance Boundary.

BL=Base Laundry
BXSS=Base Exchange Service Station
CSS=Contractor Storage Shed
ES=Enotmology Shop
FJETC=Former Jet Engine Test Cell
FLDD=Flightline Drainage Ditch
FSSB=Former Solvent Storage Building
GMZ=Groundwater Management Zone
JEBS=Jet Engine Buildup Shop
PH = pumphouse
PHC = petroleum hydrocarbons
RG = Remediation Goal
RMSA=Refueling Maintainence Shop
VMB= Vehicle Maintainence Building

Table 8.8-2

Groundwater Remediation Goals[a]
OU 12 Long-Term Monitoring Program
Five-Year Review Report
Former Loring AFB, Limestone, Maine

	Contaminated Groundwater Area RGs by Plume											
	GMZ 2		GMZ 3				GMZ 4		GMZ 5		GMZ 6	
Chemical of Concern [b]	FTF	Compliance Boundary	Upgradient BXSS	Building 8711	BXSS	Compliance Boundary	Quarry	Compliance Boundary	FJETC	Compliance Boundary	FTA	Compliance Boundary
Volatile Organics												
4-Methyl-2-pentanone											530	530
1,1-Dichloroethene							7	7				
1,2-Dichoroethane							5	5				
Benzene					5	5	5	5	5	5	5	5
Carbon Tetrachloride							5	2.7			5	2.7
Chloroform								100				
Chloromethane											2.2	3
cis-1,2-Dichloroethene							70	70	70	70		
Ethylbenzene							700	700				
Methyl-Tert-butyl ether					3080	50						
Naphthalene							480	25	480	25	480	25
Tetrachloroethylene	5	3		5		3	5	3			5	3
Toluene							1000	1000				
Trichloroethylene			5	5		5	5	5	5	5	5	5
Vinyl Chloride	2	0.15					2	0.15	2	0.15	2	0.15
Xylene										600		600
PCBs				0.5		0.1						
Inorganics												
Cadmium											5	5
Iron (Bedrock only)											8330	8330
Lead											15	15
Manganese (Bedrock only)											396	200
PHCs [c]						361		361		361		361

NOTES:

[a] Groundwater Remediation Goals (RGs) documented in OU12 Record of Decision (HLA, 1999)

[b] All concentrations are in micrograms per liter (µg/L)

[c] There is no Contaminated Groundwater Area RG for PHCs; however, there is a risk-based screening value (i.e., 361 µg/L) for monitoring PHCs at the GMZ Compliance Boundary.

BXSS=Base Exchange Service Station
FJETC=Former Jet Engine Test Cell
FTA=Fire Training Area
FTF=Fuels Tank Farm
GMZ=Groundwater Management Zone
PCBs= polychlorinated biphenyls
PHC = petroleum hydrocarbons

Table 8.9-1

Sediment and Surface Soil Remediation Goals[1]
Five-Year Review Report
Former Loring AFB, Limestone, Maine

NDA Drainageways							
Contaminant of Concern[2]	**Maximum Detected Concentration[3] (mg/kg)**		**Protection of Human Health[4] (mg/kg)**	**Protection of Ecological Receptors[5] (mg/kg)**		**Remediation Goal[6] (mg/kg)**	
	Sediment	**Soil**	**Sediment/Soil**	**Sediment**	**Soil**	**Sediment**	**Soil**
Total PAHs	270	NS	**	35/87	2,900	35/87* (ECO)	2,900 (ECO)
Lead	427	NS	690	218	320	218 (ECO)	320 (ECO)
Zinc	952	NS	>1,000,000	410	900	410 (ECO)	900 (ECO)

Notes:

1. Ditch sediment remediation goals are based on human and ecological exposure to sediment within the boundaries of the existing ditch channel plus soil in the overbank areas out to 20 feet from the existing ditch banks. Surface-soil remediation goals are based on human and ecological exposure to soil in the overbank areas more than 20 feet from the existing ditch banks.

2. Ecological risk-based concentrations were derived for the primary risk contributors only (i.e., those accounting for >90% of the overall hazard index).

3. Maximum concentration is only for the sample locations in the area proposed for remediation and includes 1993 and later analytical data. Maximum concentrations of total PAHs are the sum of the maximum concentrations of the individual compounds.

4. The lesser value of a carcinogenic risk-based concentration calculated with the cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1 of the OU 13 FS (ABB-ES, 1997).

5. Development of ecological risk-based concentrations is documented in Appendix A.2 of the OU 13 FS (ABB-ES, 1997).

6. Remediation goals represent the lower of the human health and ecological criteria.

ECO - Remediation goal is ecological risk-based concentration.
mg/kg - milligrams per kilogram
NS - No samples were collected for this medium in this habitat.
PAHs - polynuclear aromatic hydrocarbons
* - 35/87 represents the RG for upper ditch areas/RG for lower wetland areas.
** - Development of human health risk-based concentrations for total PAHs is unnecessary; no noncarcinogenic risk on site was attributed to noncarcinogenic effects from PAHs.

Table 8.9-1

Sediment and Surface Soil Remediation Goals[1]
Five-Year Review Report
Former Loring AFB, Limestone, Maine

East Branch Greenlawn Brook								
Contaminant of Concern[2]	**Maximum Detected Concentration[3] (mg/kg)**		**Protection of Human Health[4] (mg/kg)**		**Protection of Ecological Receptors[5] (mg/kg)**		**Remediation Goal[6] (mg/kg)**	
	Stream	**Palustrine**	**Stream**	**Palustrine**	**Stream**	**Palustrine**	**Stream**	**Palustrine**
Total PAHs	54	NS	**	**	35	230	35 (ECO)	230 (ECO)
Total 4,4'-DDT/DDD/DDE	0.372	NS	77	125	0.28	0.37	0.280 (ECO)	0.370 (ECO)
Aroclor-1260	10	NS	2.5	5.5	1	14	1 (ECO)	5* (HH)
Total Chlordanes	0.11	NS	18	29	0.48	0.32	0.480 (ECO)	0.320 (ECO)
Lead	126	NS	690	690	218	155	218 (ECO)	155 (ECO)

Notes:

1. Stream sediment remediation goals are based on human and ecological exposure to sediment within the boundaries of the existing stream channel plus sediment in the overbank areas out to 20 feet from the existing stream banks. Palustrine sediment remediation goals are based on human and ecological exposure to sediment in the overbank areas more than 20 feet from the existing stream channel.

2. Ecological risk-based concentrations were derived for the primary risk contributors only (i.e., those accounting for >90% of the overall hazard index).

3. Maximum concentration is only for the sample locations in the area proposed for remediation and includes 1993 and later analytical data. Maximum concentrations of total PAHs, total 4,4'-DDT/DDD/DDE, and total chlordanes are the sum of the maximum concentrations of the individual compounds.

4. The lesser value of a carcinogenic risk-based concentration calculated with the cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1 of the OU 13 FS (ABB-ES, 1997).

5. Development of ecological risk-based concentrations is documented in Appendix A.2 of the OU 13 FS (ABB-ES, 1997).

6. Remediation goals represent the lower of the human health and ecological criteria.

DDD - dichlorodiphenyldichloroethane

DDE - dichlorodiphenyldichloroethylene

DDT - dichlorodiphenyltrichloroethylene

ECO - Remediation goal is ecological risk-based concentration.

HH - Remediation goal is human health risk-based concentration.

mg/kg - milligrams per kilogram

NS - No samples were collected for this medium in this habitat.

PAHs - polynuclear aromatic hydrocarbons

* - Operationally, 5 mg/kg is used rather than the risk-based value of 5.5 mg/kg.

** - Development of human health risk-based concentrations for total PAHs is unnecessary; no noncarcinogenic risk on site was attributed to noncarcinogenic effects from PAHs.

Table 8.9-1

Sediment and Surface Soil Remediation Goals[1]
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Flightline Drainage Ditch							
	Maximum Detected Concentration[3] (mg/kg)		Protection of Human Health[4] (mg/kg)	Protection of Ecological Receptors[5] (mg/kg)		Remediation Goal[6] (mg/kg)	
Contaminant of Concern[2]	**Stream**	**Floodplain**	**Stream/Floodplain**	**Stream**	**Floodplain**	**Stream**	**Floodplain**
Benzo(a)pyrene	11	13	5.14	--	--	5.14 (HH)	5.14 (HH)
Benzo(a)anthracene	11	17	51.4	--	--	51.4 (HH)	51.4 (HH)
Benzo(b)fluoranthene	12	30	51.4	--	--	51.4 (HH)	51.4 (HH)
Benzo(k)fluoranthene	12	30	514	--	--	514 (HH)	514 (HH)
Chrysene	12	15	5,140	--	--	5,140 (HH)	5,140 (HH)
Dibenzo(a,h)anthracene	3.1	2.4	5.14	--	--	5.14 (HH)	5.14 (HH)
Indeno(1,2,3-c,d)pyrene	8.1	7.7	51.4	--	--	51.4 (HH)	51.4 (HH)
Total PAHs	168	225	**	35	597	35 (ECO)	597 (ECO)
Total 4,4'-DDT/DDD/DDE	0.345	0.499	125	0.49	0.372	0.490 (ECO)	0.372 (ECO)
Aroclor-1260	6.4	5.9	5.5	1	14	1 (ECO)	5* (HH)
Total Chlordanes	0.64	0.12	29	0.6	0.315	0.600 (ECO)	0.315 (ECO)
Lead	332	474	690	218	155	218	155 (ECO)

Notes:

1. Stream sediment remediation goals are based on human and ecological exposure to sediment within the boundaries of the existing stream channel plus sediment in the overbank areas out to 10 feet from the existing stream banks. Floodplain sediment remediation goals are based on human and ecological exposure to sediment in the overbank areas more than 10 feet from the existing stream channel.

2. Ecological risk-based concentrations were derived for the primary risk contributors only (i.e., those accounting for >90% of the overall hazard index).

3. Maximum concentration is only for the sample locations in the area proposed for remediation and includes 1993 and later analytical data. Maximum concentrations of total PAHs, total 4,4'-DDT/DDD/DDE, and total chlordanes are the sum of the maximum concentrations of the individual compounds.

4. The lesser value of a carcinogenic risk-based concentration calculated with the cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1 of the OU 13 FS (ABB-ES, 1997).

5. Development of ecological risk-based concentrations is documented in Appendix A.2 of the OU 13 FS (ABB-ES, 1997).

6. Remediation goals represent the lower of the human health and ecological criteria.

DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethylene
ECO - Remediation goal is ecological risk-based concentration.
HH - Remediation goal is human health risk-based concentration
mg/kg - milligrams per kilogram
samples
PAHs - polynuclear aromatic hydrocarbons

-- Development of ecological risk-based concentrations for carcinogenic PAHs is unnecessary; ecological criteria listed for total PAHs is considered
* - Operationally, 5 mg/kg is used rather than the risk-based value of 5.5 mg/kg.
** - Development of human health risk-based concentrations for total PAHs is unnecessary; no noncarcinogenic risk on site was attributed to

Table 8.9-1

Sediment and Surface Soil Remediation Goals[1]
Five-Year Review Report
Former Loring AFB, Limestone, Maine

Flightline Drainage Ditch Wetland							
	Maximum Detected Concentration[3] (mg/kg)		Protection of Human Health[4] (mg/kg)	Protection of Ecological Receptors[5] (mg/kg)		Remediation Goal[6] (mg/kg)	
Contaminant of Concern[2]	**Stream**	**Floodplain**	**Stream/Floodplain**	**Stream**	**Floodplain**	**Stream**	**Floodplain**
Benzo(a)pyrene	5.1	4.6	5.14	--	--	5.14 (HH)	5.14 (HH)
Benzo(a)anthracene	6.2	4.5	51.4	--	--	51.4 (HH)	51.4 (HH)
Benzo(b)fluoranthene	9.8	6.9	51.4	--	--	51.4 (HH)	51.4 (HH)
Benzo(k)fluoranthene	9.8	8.9	514	--	--	514 (HH)	514 (HH)
Chrysene	6	5	5,140	--	--	5,140 (HH)	5,140 (HH)
Dibenzo(a,h)anthracene	0.92	0.99	5.14	--	--	5.14 (HH)	5.14 (HH)
Indeno(1,2,3-c,d)pyrene	2.6	4.4	51.4	--	--	51.4 (HH)	51.4 (HH)
Total PAHs	94	70	**	87	597	87 (ECO)	597 (ECO)
Total 4,4'-DDT/DDD/DDE	96.7	2.68	125	0.35	0.372	0.350 (ECO)	0.372 (ECO)
Aroclor-1260	140	19	5.5	1	14	1 (ECO)	5* (HH)
Total Chlordanes	50	2.4	29	0.6	0.315	0.600 (ECO)	0.315 (ECO)
Lead	454	313	690	218	155	218 (ECO)	155 (ECO)

Notes:

1. Stream sediment remediation goals are based on human and ecological exposure to sediment within the boundaries of the existing stream channel plus sediment in the overbank areas out to 20 feet from the existing stream banks. Floodplain sediment remediation goals are based on human and ecological exposure to sediment in the overbank areas more than 20 feet from the existing stream channel.

2. Ecological risk-based concentrations were derived for the primary risk contributors only (i.e., those accounting for >90% of the overall hazard index).

3. Maximum concentration is only for the sample locations in the area proposed for remediation and includes 1993 and later analytical data. Maximum concentrations of total PAHs, total 4,4'-DDT/DDD/DDE, and total chlordanes are the sum of the maximum concentrations of the individual compounds.

4. The lesser value of a carcinogenic risk-based concentration calculated with the cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1 of the OU 13 FS (ABB-ES, 1997).

5. Development of ecological risk-based concentrations is documented in Appendix A.2 of the OU 13 FS (ABB-ES, 1997).

6. Remediation goals represent the lower of the human health and ecological criteria.

DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethylene
ECO - Remediation goal is ecological risk-based concentration.
HH - Remediation goal is human health risk-based concentration.
mg/kg - milligrams per kilogram
PAHs - polynuclear aromatic hydrocarbons

-- Development of ecological risk-based concentrations for carcinogenic PAHs is unnecessary; ecological criteria listed for total PAHs is considered adequate protection from carcinogenic and noncarcinogenic PAHs.

* - Operationally, 5 mg/kg is used rather than the risk-based value of 5.5 mg/kg.

** - Development of human health risk-based concentrations for total PAHs is unnecessary; no noncarcinogenic risk on site was attributed to noncarcinogenic effects

Table 8.9-1

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Ditch G06							
Contaminant of Concern[2]	**Maximum Detected Concentration[3] (mg/kg)**		**Protection of Human Health[4] (mg/kg)**	**Protection of Ecological Receptors[5] (mg/kg)**		**Remediation Goal[6] (mg/kg)**	
	Sediment	**Soil**	**Sediment/Soil**	**Sediment**	**Soil**	**Sediment**	**Soil**
Total PAHs	103	71	**	35	597	35 (ECO)	597 (ECO)

Notes:

1. Ditch sediment remediation goals are based on human and ecological exposure to sediment within the boundaries of the existing ditch channel plus soil in the overbank areas out to 10 feet from the existing ditch banks. Surface-soil remediation goals are based on human and ecological exposure to soil in the overbank areas more than 10 feet from the existing ditch channel.

2. Ecological risk-based concentrations were derived for the primary risk contributors only (i.e., those accounting for >90% of the overall hazard index).

3. Maximum concentration is only for the sample locations in the area proposed for remediation and includes 1993 and later analytical data. Maximum concentrations of total PAHs are the sum of the maximum concentrations of the individual compounds.

4. The lesser value of a carcinogenic risk-based concentration calculated with the cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1 of the OU 13 FS (ABB-ES, 1997).

5. Development of ecological risk-based concentrations is documented in Appendix A.2 of the OU 13 FS (ABB-ES, 1997).

6. Remediation goals represent the lower of the human health and ecological criteria.

ECO - Remediation goal is ecological risk-based concentration.

mg/kg - milligrams per kilogram

PAHs - polynuclear aromatic hydrocarbons

** - Development of human health risk-based concentrations for total PAHs is unnecessary; no noncarcinogenic risk on site was attributed to noncarcinogenic effects from PAHs.

Table 8.9-1

Sediment and Surface Soil Remediation Goals[1]
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UTS Wetland							
	Maximum Detected Concentration[3] (mg/kg)		Protection of Human Health[4] (mg/kg)	Protection of Ecological Receptors[5] (mg/kg)		Remediation Goal[6] (mg/kg)	
Contaminant of Concern[2]	Sediment	Soil	Sediment/Soil	Sediment	Soil	Sediment	Soil
Total 4,4'-DDT/DDD/DDE	0.184	NS	125	0.012	0.012	0.012 (ECO)	0.012 (ECO)
Aroclor-1260	ND	NS	5.5	1	14	1 (ECO)	5* (HH)
Total Chlordanes	1.32	NS	29	0.32	0.32	0.320 (ECO)	0.320 (ECO)
Endrin	0.012	NS	1,768	0.21	0.21	0.21 (ECO)	0.21 (ECO)
Lead	201	NS	690	155	155	155 (ECO)	155 (ECO)
Zinc	302	NS	1,800,000	370	370	370 (ECO)	370 (ECO)

Notes:

1. Sediment remediation goals are based on human and ecological exposure to sediment within the area identified as aquatic habitat. Surface-soil remediation goals are based on human and ecological exposure to soil outside the area identified as aquatic habitat.
2. Ecological risk-based concentrations were derived for the primary risk contributors only (i.e., those accounting for >90% of the overall hazard index).
3. Maximum concentration is only for the sample locations in the area proposed for remediation and includes 1993 and later analytical data. Maximum concentrations of total PAHs are the sum of the maximum concentrations of the individual compounds.
4. The lesser value of a carcinogenic risk-based concentration calculated with the cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1 of the OU 13 FS (ABB-ES, 1997).
5. Development of ecological risk-based concentrations is documented in Appendix A.2 of the OU 13 FS (ABB-ES, 1997).
6. Remediation goals represent the lower of the human health and ecological criteria.

DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethylene
ECO - Remediation goal is ecological risk-based concentration.
HH - Remediation goal is human health risk-based concentration.
mg/kg - milligrams per kilogram
ND - Non detect
NS - No samples were collected for this medium in this habitat.
* - Operationally, 5 mg/kg is used rather than the risk-based value of 5.5 mg/kg.

Table 8.9-1

Sediment and Surface Soil Remediation Goals[1]
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Fish Tissue				
Contaminant of Concern[2]	**Maximum Detected Concentration[3] (mg/kg)**	**Protection of Human Health[4] (mg/kg)**	**Protection of Ecological Receptors[5] (mg/kg)**	**Remediation Goal[6] (mg/kg)**
4,4'-DDD	0.076	0.018	TBD	0.6a
4,4'-DDE	0.044	0.013	TBD	1.09b
4,4'-DDT	0.14	0.013	TBD	>0.04c,d
Aroclor-1242	0.074	0.0022	TBD	0.031d,e
Aroclor-1260	2.1	0.0022	TBD	0.031d,e
Heptachlor	0.0031	0.00098	TBD	4.5f
Chlordane, Alpha	0.042	0.0034	TBD	NA
Chlordane, Gamma	0.014	0.0034	TBD	NA

Notes:

1. Contaminants of concern identified in fish tissue at one or more of the affected areas.
2. Maximum detected concentration out of all the affected areas.
3. The lesser value of a carcinogenic risk-based concentration calculated with the target cancer risk set at 1x10-6 and a noncarcinogenic risk-based concentration with the hazard quotient set at 1. Development of human health risk-based concentrations is documented in Appendix A.1of the OU 13 FS (ABB-ES, 1997).
4. Remediation Goals will be based on bioaccumulation hazard to semi-aquatic receptors and will be calculated at the time of sampling and analysis using the most current guidance and information (i.e., reference toxicity values) available at the time.
5. Lowest Observed Effect Concentrations (LOECs) for fish tissue residues based on information provided by NOAA and included in the ACOE/USEPA Environmental Residue-Effects Database (ERED). LOECs are considered equivalent to Maximum Acceptable Tissue Concentrations for the Protection of Fish.

a - Threshold for reproductive effects in Pimephales promelas

b - Threshold for mortality in Salvelinus namaychus

c - Threshold for reproductive effects (increased hatchling mortality) in salmonids

d - Converted from an egg to a whole body residue concentration assuming a 10-fold application factor (jay et al., 1984)

e - Threshold for reproductive effects (reduced egg hatchability) in lake trout

f - Threshold for behavioral effects in Cyprinodon variegatus

DDD - dichlorodiphenyldichloroethane

DDE - dichlorodiphenyldichloroethylene

DDT - dichlorodiphenyltrichloroethylene

ECO - Remediation goal is ecological risk-based concentration.

mg/kg - milligrams per kilogram

NA - Not Applicable